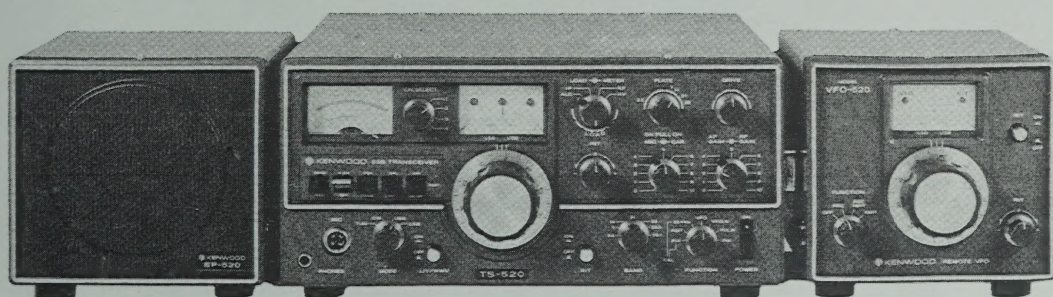
 **KENWOOD/TRIO**

# SERVICE MANUAL

**Model**      **TS-520**  
**VFO-520**  
**SP-520**



**SSB TRANSCEIVER**

# CONTENTS

EXTERNAL VIEW .....	1
PARTS ALIGNMENT .....	2
SECTION 1. INTRODUCTION .....	3
SECTION 2. TROUBLE-SHOOTING .....	3
SECTION 3. MAINTENANCE AND ALIGNMENT .....	6
PARTS LIST .....	16
PC BOARD .....	27
VFO-520	
EXTERNAL VIEW .....	36
SPECIFICATION .....	36
PARTS LIST .....	37
SCHEMATIC DIAGRAM .....	38
SP-520	
EXTERNAL VIEW .....	39
PARTS LIST .....	39
SPECIFICATION .....	39
SCHEMATIC DIAGRAM (RF UNIT) .....	40
SCHEMATIC DIAGRAM .....	41



# EXTERNAL VIEW

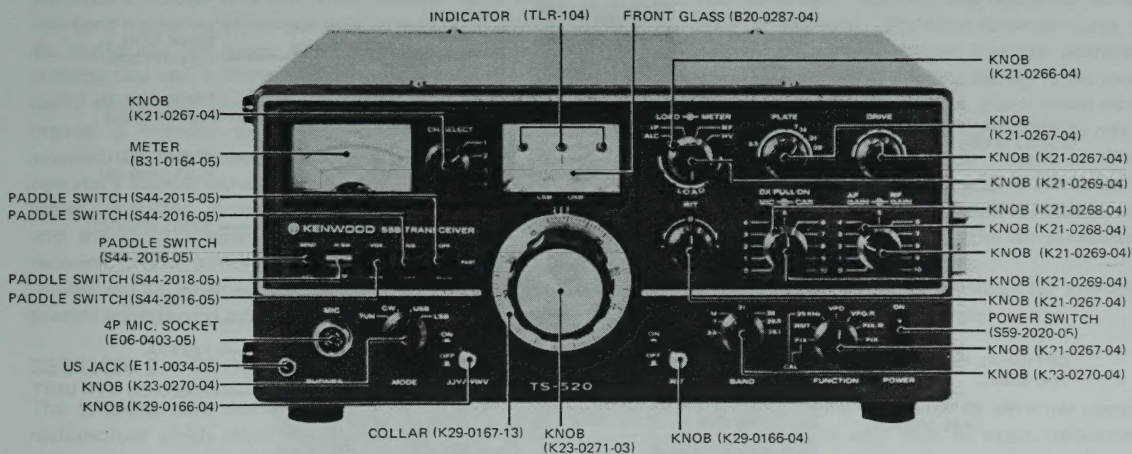


Figure 1. TS-520 FRONT PANEL PARTS

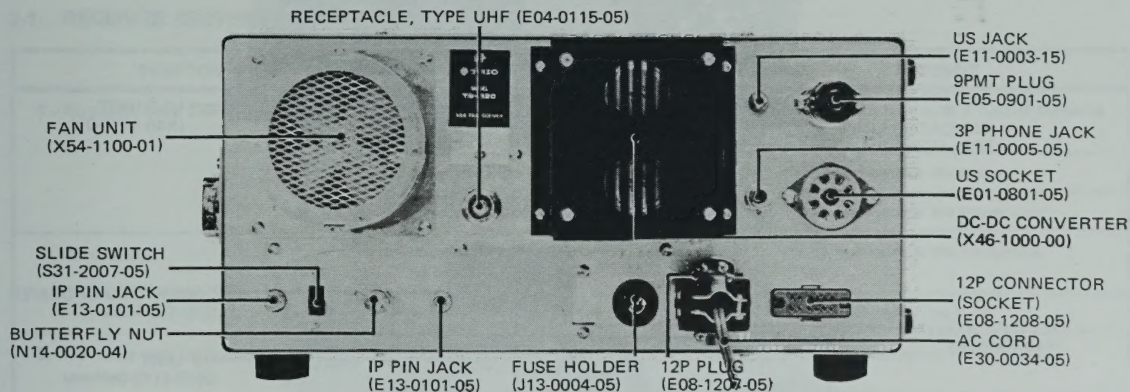


Figure 2. TS-520 REAR PANEL PARTS

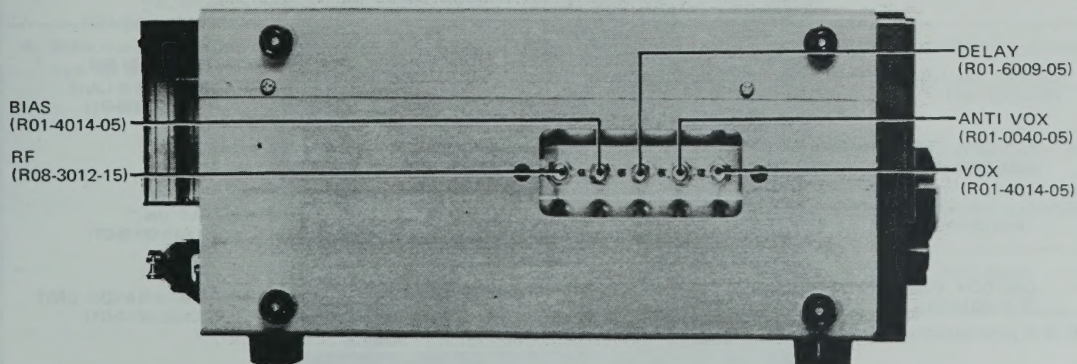


Figure 3. TS-520 SIDE CONTROLS



# PARTS ALIGNMENT

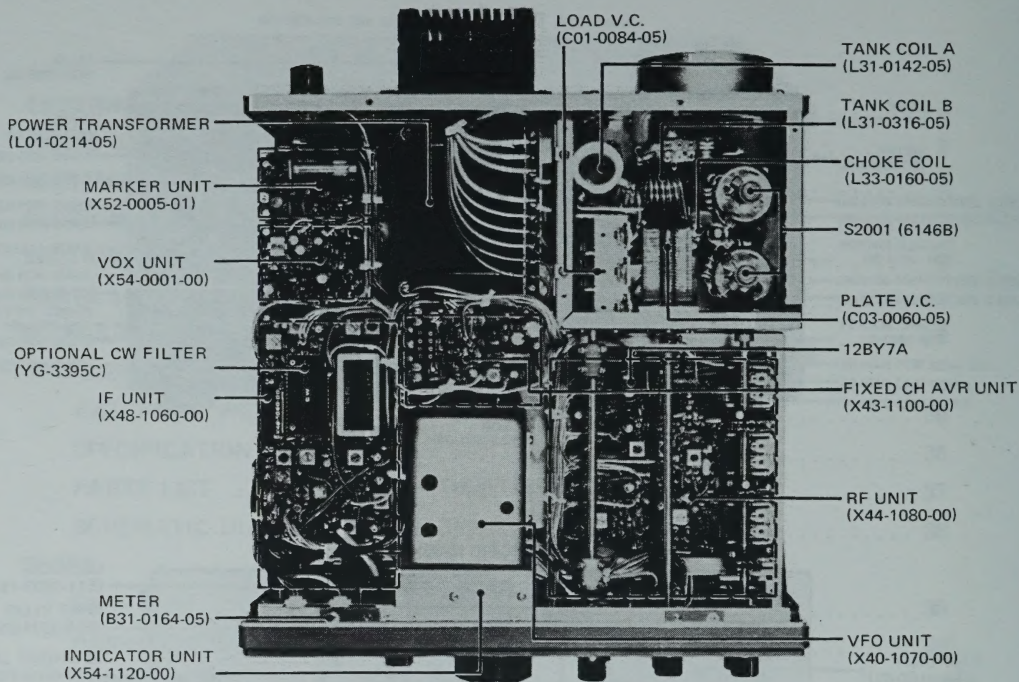


Figure 4. TS-520 TOP VIEW PARTS

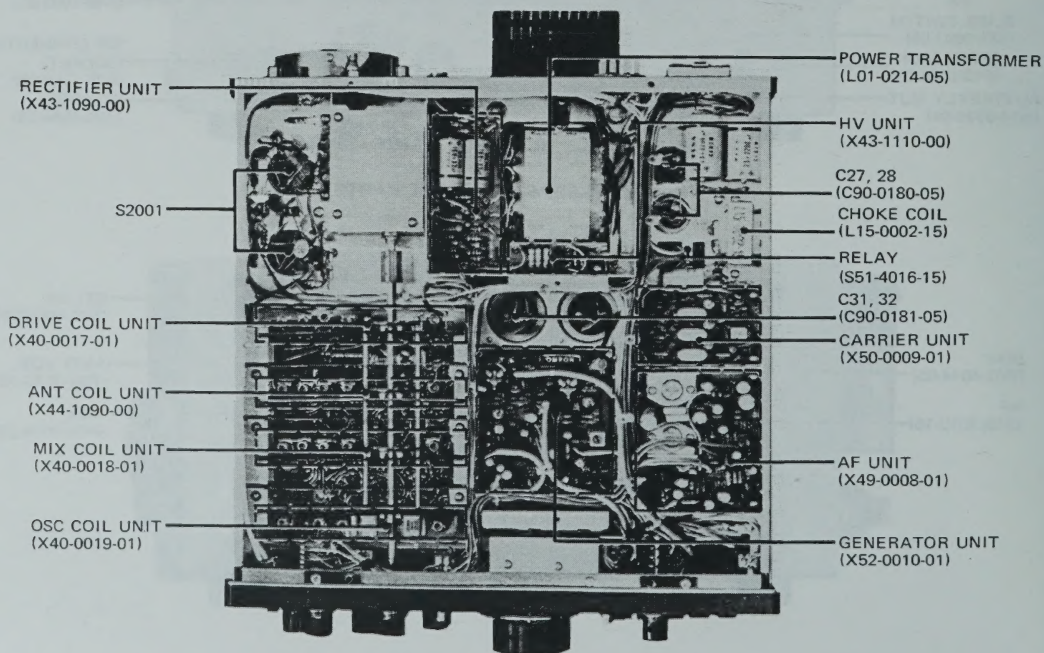


Figure 5. TS-520 BOTTOM VIEW PARTS

## SECTION 1. INTRODUCTION

Kenwood's TS-520 is a solid-state, amateur band single side band transceiver which uses only three vacuum tubes in the exciter and final stages. The TS-520 incorporates many sophisticated and modern features which make it a very useful transceiver. The information included in this service manual is intended to complement the technical data supplied in the operator's manual. For example the operator's manual includes pictorial parts displays, voltage tables, operating instructions, a troubleshooting chart, and the block diagram. This service manual includes technical service procedures, a parts list, circuit board layouts and full schematics. Together, the two publications provide full technical information.

## SECTION 2. TROUBLE-SHOOTING

The following table describes possible causes of different malfunctions which might occur when the transceiver is connected and operated as described in the operating

TS-520 was completely adjusted and inspected at the factory prior to shipment. The most common causes of service problems are shipping damage, improper operation, or component ageing. When shipping damage is the cause of trouble, check for loose connectors, disconnected wires, damaged or open circuits, or mechanical damage to relays, crystals, or other parts vulnerable to vibrations. When component ageing or improper operation is the cause of service problems, check for deteriorated or burned out parts. The troubleshooting table is useful for pin-pointing some problems.

Be certain to check in the operating manual for a detailed circuit description and the block diagram.

manual. When problems are caused by defective components, replace the part only with its exact replacement or a close equivalent.

### 2-1. RECEIVER SECTION

SYMPTOM	CAUSE	REMEDY
1. No power from power supply.	1. Blown fuse.	Replace the fuse with a fuse of the same value.
	2. Defective POWER switch.	Check and replace the switch.
	3. Defective power cord.	Check and replace the power cord.
2. Blown fuse.	1. Defective transistors on the AUDIO board - Q3 and/or Q4.	Check and replace the transistors.
	2. B + circuit shorted to chassis.	Locate and repair the short.
3. No noise can be heard from the speaker.	1. Defective speaker or disconnected speaker plug.	Check and replace or reattach the speaker.
	2. Defective transistors on the AUDIO board - Q3 and/or Q4.	Check and replace the defective transistors.
	3. PHONES or SPEAKER jack contacts are broken.	Check and replace the defective jack.
4. Noise, but no signals, can be heard from the speaker.	1. AF GAIN or RF GAIN controls are defective.	Check and replace the defective controls.
	2. TC1 on the CARRIER board requires tuning.	See Section 3.26.
	3. Defective diode switching on the CARRIER board.	Check and replace defective diodes.
		Check the continuity of the MODE switch.
	4. Output from the AVR board may be unregulated.	Check and repair the AVR board.
	5. EXT VFO jumper plug is not inserted.	Be certain this jumpered plug is in the socket.
	6. FUNCTION switch is set to a fixed channel position.	Set the switch to the proper position.



SYMPTOM	CAUSE	REMEDY
	7. The coaxial VFO output cable is disconnected.	Reconnect the cable.
	8. Defective transistor on the VFO board.	Check and repair the VFO board.
	9. The coils on the OSC COIL board require tuning.	See Section 3-13.
	10. A defective switch on the OSC COIL board.	Check and replace the switch wafer.
	11. Q1 and/or Q2 on the RF board are defective.	Check and replace the defective transistors.
	12. Q1, Q3, Q4 and/or Q9 on the IF board are defective.	Check and replace the defective transistors per Figure.
	13. IF transformers T1, T2, T5, T6, and/or T9 may be misaligned or defective.	See Section 3-15.
	14. Band pass filter requires alignment.	See Section 3-12.
	15. Bias circuit on IF board not normal.	Check voltages at terminals RB, 14V and AGC.
	16. Filter diode switch on IF board defective.	Check voltages and operation by Figure 14.
	17. ANT or RF coils require alignment.	See Section 3-13.
	18. Defective switch wafer in the RF section.	Check and replace the defective switch.
	19. Disconnected coax on ANT board or at the 8.6 MHz trap.	Reconnect the coax.
	20. Defective relay in the final section.	See Section 3-2.
	21. Defective tuning capacitor.	Check the capacitor after disconnecting the leads at terminals MVC and DVC of the DRIVE board.
	22. Defective Q4 and/or Q5 on the RF board.	Check the transistors per Figure.
	23. Carrier unbalanced on GENERATOR board.	See Section 3-17.
5. S-meter does not read correctly.	1. Zero adjust VR1 on IF board requires calibration.	See Section 3-18.
	2. S-meter sensitivity adjust, VR2 on the IF board, requires calibration.	See Section 3-18.
	3. Defective AGC circuit (Q5 or Q6) on IF board.	Check the circuit and replace the defective transistors.
	4. Open circuit at L4, L6, or terminal RFC of the IF board.	Repair as necessary.
	5. Defective relay in final section.	Replace the relay.
6. S-meter does not return to zero.	1. Reference voltage for RF1 on the FIX. AVR board requires adjustment.	See Section 3-18.
	2. Carrier requires balancing.	See Section 3-17.
7. Calibrator inoperative.	1. Defective FUNCTION switch at wafer S2-4 on MARKER board.	Check continuity at terminal 9.

SYMPTOM	CAUSE	REMEDY
	2. Coax cable disconnected from terminal MO on MARKER board.	Check the connection.
	3. Open circuit L1 on the MARKER board.	Check and repair the circuit.
	4. Defective Q1 on MARKER board.	Check and replace the defective transistor.
	5. Defective crystal on the MAKER board.	Replace the crystal.
8. No WWV reception.	1. Defective WWV switch, S9.	Check and replace the defective switch.
	2. Coil T3 on RF board misaligned.	See Section 3-14.
	3. Defective Q7 on the RF board.	Check and replace the defective transistor.
	4. Defective or misaligned T5 on the RF board.	Check and replace the defective coil.

## 2-2. TRANSMITTER SECTION

SYMPTOM	CAUSE	REMEDY
1. No ouptut or low output.	1. Defective final tubes. S2001 (6146A)	Replace the tubes.
	2. Defective switch, S5, in final section.	Check and replace the defective switch.
	3. Defective relay in final section.	Check and replace the defective relay.
	4. Loading capacitor shorted.	Check the conduction of the capacitor and replace if defective.
	5. Carrier, VFO, or heterodyne oscillator boards may be defective.	See Sections 3-13, 3-21, or 3-26.
	6. Defective driver tube (12BY7A).	Replace the tube.
	7. Defective relay RL1 on GENERATOR board.	Check the conduction of the coil and contacts.
	8. Defective MODE switch wafer (S3-7) on GENERATOR board.	Check the continuity of the switch contacts.
	9. Defective Q4 on the GENERATOR board.	Check and replace the transistor.
	10. Defective MIC GAIN control.	Check and replace the defective control.
	11. SG switch is off or defective.	Check the continuity of the rear panel SG switch.
2. Output is normal but the meter shows no output.	1. The RF VOLT control is improper adjusted.	Adjust the RF VOLT control.
	2. Defective meter.	Check the meter and replace if necessary.
3. No ALC meter reading.	1. Q10 on RF board is defective.	Check and replace the transistor.
	2. Insufficient drive.	See Section 2-2-1.
	3. Shorted ALC circuit.	Trace the circuit and repair as necessary.
	4. Defective RL1.	Check and replace the defective relay.



SYMPTOM	CAUSE	REMEDY
4. No HV meter reading.	1. Defective components in power supply section.	Troubleshoot the power supply.
	2. Defective or disconnected meter circuit.	Troubleshoot the meter circuit.
5. Stand-by switch is inoperative.	1. Microphone wired incorrectly.	Rewire the MIC plug.
	2. Disconnected leads at terminal VS or SS on the VOX board.	Check the continuity of the leads.
	3. Q8 or D8 on VOX board defective.	Check and replace the defective parts.
	4. Defective stand-by switch.	Check and replace the defective switch.

## 2-3. OTHER CIRCUITS

SYMPTOM	CAUSE	REMEDY
1. 9 volt supply is not regulated.	1. Transistor or diode on AVR board defective.	Check and replace the defective part.
2. The noise blanket is ineffective.	1. NB board requires adjustment.	See Section 3-15.
	2. NB switch defective.	Check and replace the defective switch.
	3. Transistors Q1 through Q6 on the NB board are defective.	Check the voltages and replace the part.
	4. Diodes D1 through D6 on NB board are defective.	Check the voltages and replace the defective part.
	5. Disconnected or defective L1 or L2 on NB board.	Check the circuit.

## SECTION 3. MAINTENANCE AND ALIGNMENT

### 3-1. GENERAL INFORMATION

Refer to the operating manual for information on how to remove the transceiver's case.

**CAUTION:** DANGEROUS HIGH VOLTAGES ARE PRESENT WITHIN THE CASE OF THE TS-520 WHEN THE TRANSCEIVER IS TURNED ON. EXERCISE EXTREME CAUTION TO AVOID ELECTRIC SHOCK.

### 3-2. REPLACING THE RELAYS (See Figure 6.)

#### ANTENNA RELAY

RL2 is enclosed on the bottom of the final section. Remove the bottom of the TS-520's case and then remove the cover of the relay shield box as shown in Figure 6A.

The standard relay has large contacts and the coil is rated at 300 ohms. Be sure to replace the relay with an exact equivalent.

#### VOX RELAY:

RL1 is located below the VOX board, as shown in Figure 6B, next to the power transformer. Remove the top cover

of the transceiver and then remove the VOX board. Replace the relay with an exact equivalent.

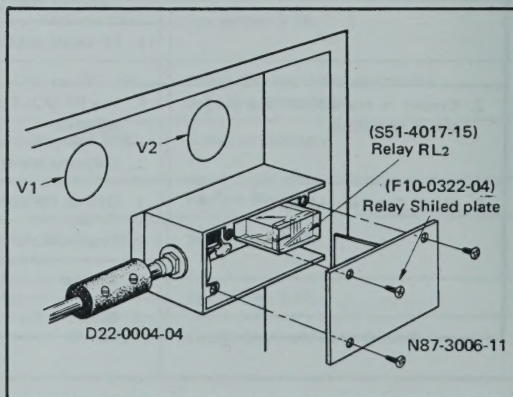


Figure 6A. Replacing the Antenna Relay.



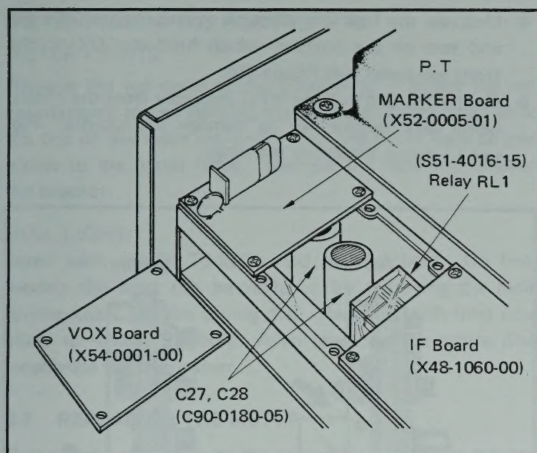


Figure 6B. Replacing the VOX Relay.

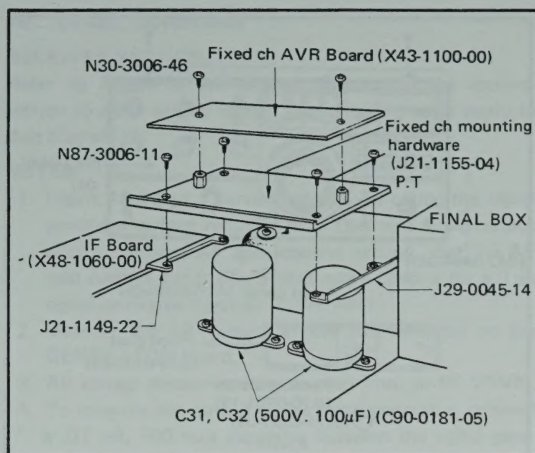


Figure 7A. Replacing C31 and C32

### 3-3. REPLACING THE ELECTROLYTIC POWER SUPPLY CAPACITORS

See Figure 7. C31 and C32 are reached by removing the TS-520's top cover and then the FIXCH-AVR board as shown in Figure 7A. C27 and C28 are reached by removing the transceiver's top case and then the MARKER and VOX boards as shown in Figure 7B.

### 3-4. DISASSEMBLY OF THE COIL PACK

When service is required on the RF board or on any of the coil boards the coil pack must be taken apart as shown in Figure 8. The assembly includes the RF board, the OSCILLATOR COIL board, the MIXER COIL board, the ANTENNA COIL board, and the DRIVER COIL board.

**PURPOSE:** To remove the RF section coil pack.

#### PROCEDURE:

1. Remove the top and bottom cover of the transceiver.
2. From the top, disconnect the lead between the square wrapping-terminal on the RF board and the COIL board to be removed.
3. Remove all of the front panel knobs and the front glass as shown in Figure 9.
4. Use a small hex nut driver to loosen the nuts at the front and/or back of the coil pack. The front nuts are reached through two holes in the front sub-panel on either side of the band switch. The front nuts must be loosened to remove the OSCILLATOR or MIXER COIL boards. The back nuts must be loosened to remove the ANTENNA or DRIVER coil boards.
5. The OSCILLATOR COIL board can be removed by pulling the screw bars towards the rear panel. For the other boards, pull the screw bars out towards the front panel.

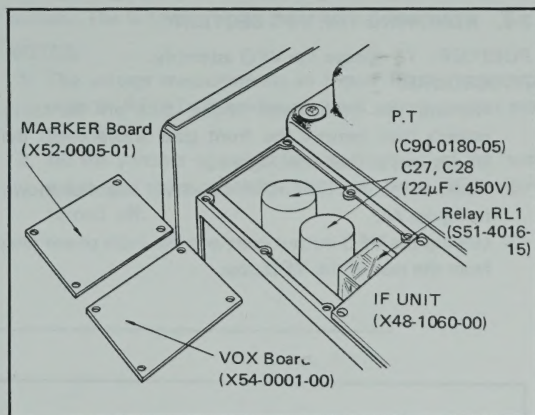


Figure 7B. Replacing C27 and C28

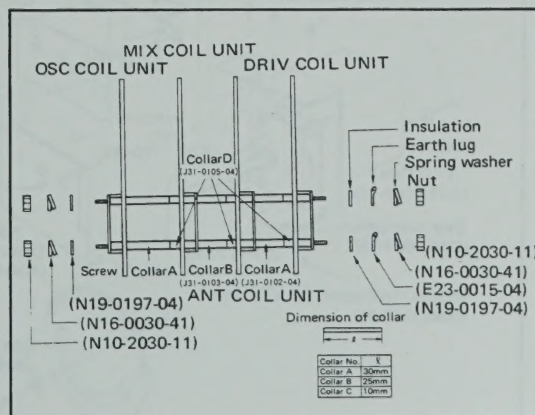


Figure 8. Coil Pack Assembly

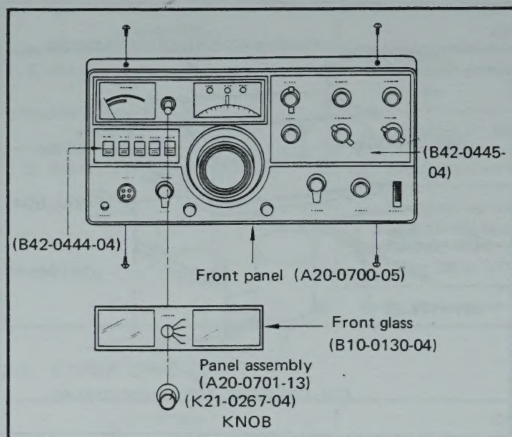


Figure 9. Removing the Front Panel

### 3-5. REMOVING THE VFO SECTION

**PURPOSE:** To remove the VFO assembly.

**PROCEDURE:**

1. Remove the front panel knobs, take off the transceiver's case, remove the front glass and pull off the front panel as shown in Figure 9.
2. Remove the FIXED CHANNEL-AVR board as shown in Figure 7A.
3. Unplug the VFO output coax and the 2-pin power plug from the rear of the VFO case.

4. Unscrew the four countersunk screws (two on the top and two on the bottom) which hold the VFO to the front sub-panel (see Figure 10).
5. Gently lift and pull the VFO assembly from the chassis being very careful not to damage the sub-dial. Figure 11 shows the entire assembly.

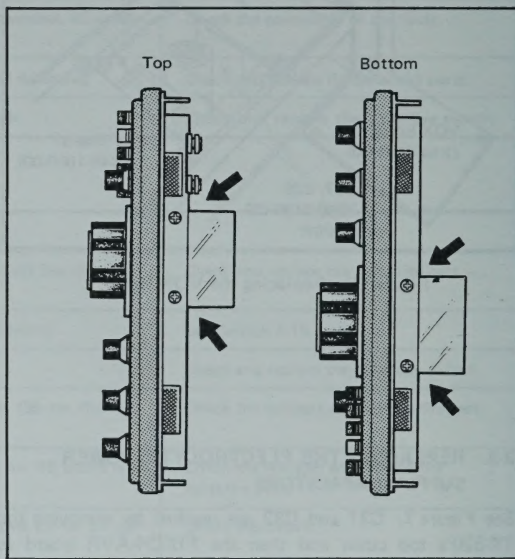


Figure 10. VFO Assembly Chassis Screws.

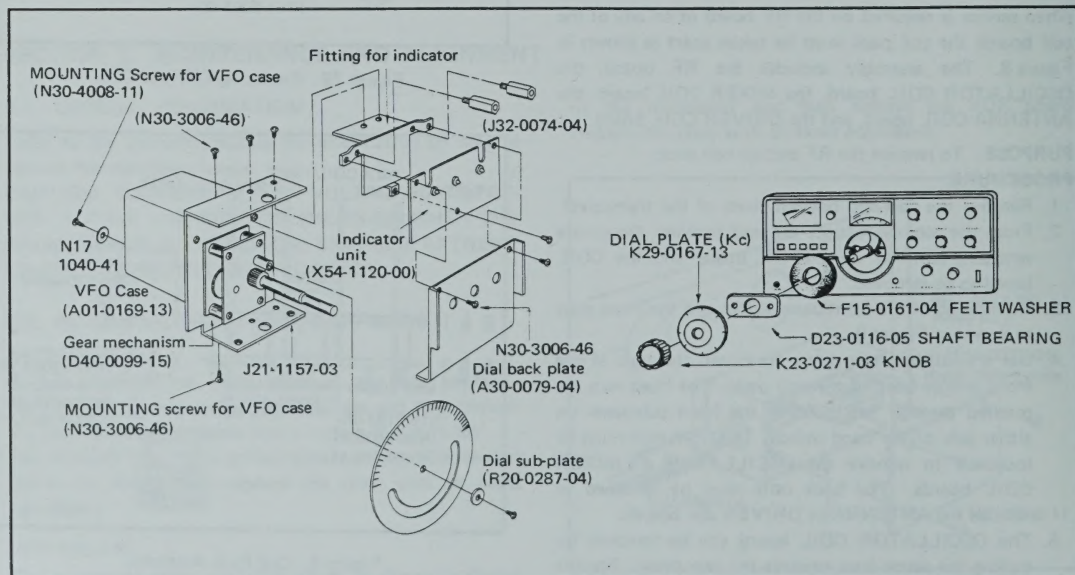


Figure 11. VFO Assembly



### 3-6. CHANGING THE PILOT LIGHTS

#### METER LIGHTS:

Remove the top cover of the transceiver. Remove the two countersunk screws holding the meter and light bracket to the top of the front sub-panel. Pull the meter back to gain access to the meter lights. Replace the light and refasten the bracket.

#### DIAL LIGHT:

Some early model TS-520's had no dial light. On later models the light can be replaced by removing the main tuning knob and the tuning dial. Reach in with long nose pliers to remove the bulb. After replacing the tuning dial, recalibrate the transceiver.

### 3-7. REPLACING THE METER

Remove the top cover of the transceiver. Remove the two countersunk screws holding the meter and light bracket to the top of the front sub-panel. Remove the six screws securing the IF board (behind the meter) and tilt the board up about 60° from its normal position. Lift the meter back and away being very careful not to scratch the meter face on the sub-panel.

### 3-8. CHANGING THE PADDLE SWITCHES

Remove the TS-520's case. Remove all the knobs from the front panel and then remove the front glass and front panel. Take out the meter, as described in Section 3-7. Pull the switch out towards the front of the transceiver while holding down the securing spring as shown in Figure 12.

Push in a new switch from the front. The switch will secure itself with a leaf spring. The paddle itself can be replaced by levering off the old paddle with a screwdriver. Then push on the new paddle.

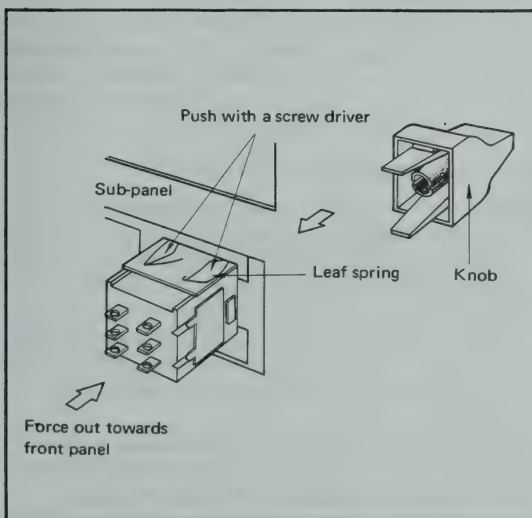


Figure 12. Replacing the Paddle Switches

### 3-9. LEVEL DIAGRAMS

#### RECEIVER SECTION:

Refer to Figure 13 for a level diagram of the receiver section to aid in service work. The following notes apply to that diagram.

#### NOTES:

1. Figure 13 shows a curve formed by plotting the signal generator output required for a constant audio output with a constant AF gain control setting. Set the AF gain control for a .63v/8 ohm audio output for a 0 db signal generator input at 14.175 MHz.
2. Measure the AF output at the ring detector on the GENERATOR board.
3. All voltage measurements are read from an RF VTVM.
4. To measure the output of the signal generator, connect a .01 mf, 500 volt capacitor between the signal generator and the voltmeter.

#### TRANSMITTER SECTION:

Refer to Figure 14 for a level diagram of the transmitter section. The following notes apply to the diagram.

#### NOTES:

1. The voltage measurements in Figure 14 are measured with an RF VTVM having an input capacitance of less than 3 pf.
2. All the voltages at and before the first grid of the final tubes are measured with the rear panel SG switch turned off.

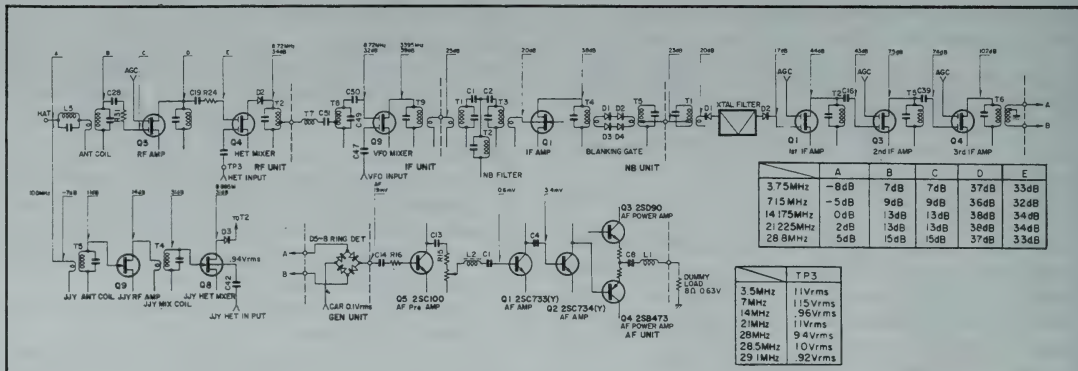


Figure 13. Receiver Section Level Diagram

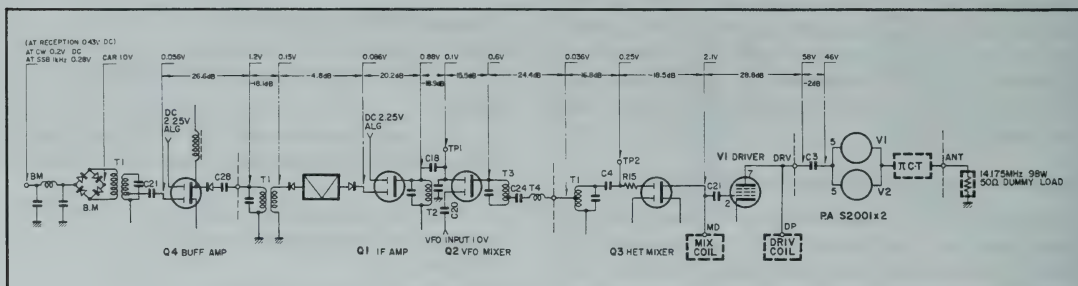


Figure 14. Transmitter Section Level Diagram

### 3-10. SERVICE INFORMATION

Be certain to see the operating manual for directions on removing the transceiver's case and information on the proper service position. Be certain that the air supply to the final tubes is not blocked.

#### INITIAL SWITCH SETTINGS:

LOCATION	SWITCH	POSITION
Front Panel:	MODE Switch	USB
	FUNCTION Switch	FIX
	RF Gain Control	Maximum
	H. SW Switch	OFF
	VOX Switch	MAN
	AGC Switch	FAST
	NB Switch	OFF
	JJY/WWV Switch	OFF
	RIT Switch	OFF
	Standby Switch	REC
	POWER Switch	ON
Rear Panel:	SG Switch	OFF
	EXT. SPEAKER Jack	8 ohm dummy load
	ANTENNA Connector	200 watt, 50 ohm dummy load

### 3-11. AVR ADJUSTMENT

**PURPOSE:** To adjust the output of the automatic voltage regulator board.

**TEST EQUIPMENT:** Voltmeter.

**PROCEDURE:** Connect the voltmeter to terminal 9 on the FIX. CH-AVR board. Adjust VR1 for a voltage reading of 9 volts  $\pm$  0.2 volts. Next connect the voltmeter to terminal RF1 on the FIX. CH-AVR board. Adjust VR3 for a meter reading of 3.3 volts  $\pm$  0.1 volt.

### 3-12. BAND PASS FILTER ADJUSTMENT

**PURPOSE:** To adjust the receive and transmit B.P.F.

**TEST EQUIPMENT:** A sweep signal generator (require frequencies at 8.295, 8.595, and 8.895 MHz), a B.P.F. wave detector (as shown in Figure 15), and an oscilloscope.

**PROCEDURE:** See Figure 16 for the test setup. After all of the connections described in Figure 16 have been made for the receiver adjustment, tune T2 on the RF board, and T7 and T8 on the IF board for the waveform shown in Figure 17.

Now make the connections for transmission as shown in Figure 16. Set the standby switch to SEND and adjust T3 and T4 on the IF board and T1 on the RF board for the waveform shown in Figure 17. Return the standby switch to REC.



**NOTE:** The FUNCTION switch is set to the FIX position to turn off the VFO. However if an accessory crystal is installed in the fixed channel oscillator, the waveform may be disturbed.

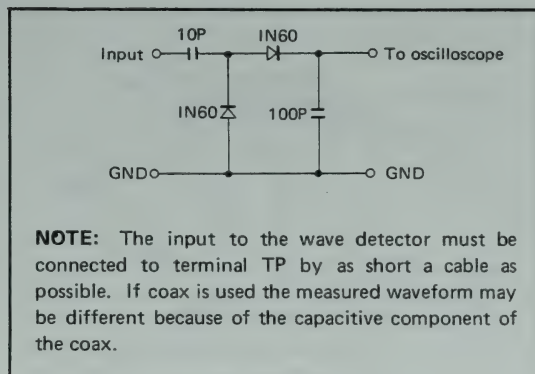


Figure 15. B.P.F. Wave Detector

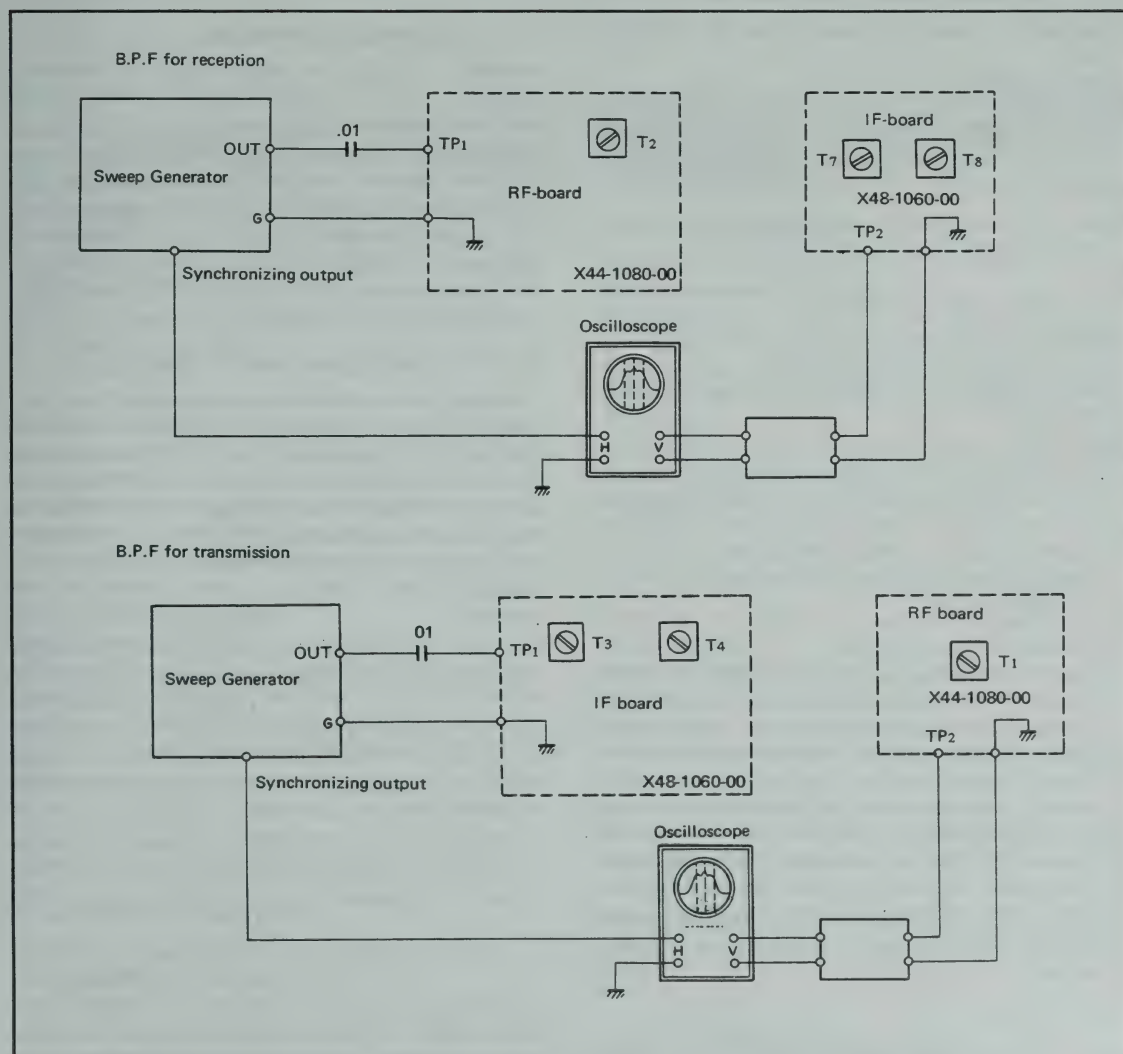


Figure 16. Band Pass Filter Test Circuit

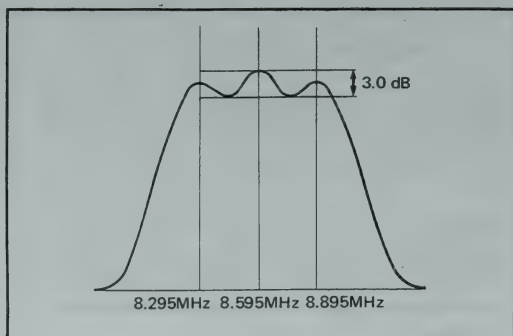


Figure 17. B.P.F. Waveform

### 3-12. CARRIER BOARD (X50-0009-01) ADJUSTMENT

**PURPOSE:** To adjust the output from the CARRIER board.

**TEST EQUIPMENT:** RF VTVM.

**PROCEDURE:** Connect the VTVM to terminal OUT on the CARRIER board. Set the FUNCTION switch to VFO and adjust T1 on the CARRIER board for a maximum voltage at the output.

**NOTE:** The carrier can not be adjusted when the FUNCTION switch is turned to CAL-FIX or CAL-RMT.

### 3-13. COIL PACK ALIGNMENT

**PURPOSE:** To align the OSCILLATOR, MIXER, ANTENNA, and DRIVER coils of the transceiver.

**TEST EQUIPMENT:** An RF VTVM and a signal generator.

**PROCEDURE:**

**HETERODYNE OSCILLATOR COILS:**

Connect the RF VTVM to terminal TP3 on the RF board. For the 3.5 MHz band adjust the 3.5 MHz oscillator coil for a maximum reading on the VTVM. Then turn the core counterclockwise for a voltage reading 1 db lower than the maximum. Repeat the same procedure for the 7, 14, 21, and 28.5 MHz bands.

**ANTENNA AND MIXER COILS:**

Set the FUNCTION switch to VFO, remove the VTVM, and connect the signal generator to the ANTENNA connector. Turn the DRIVE control to the 12 o'clock position. Table 1 below describes the adjustment order and frequencies for this alignment. Receive the signal generator output at the designated frequency and carefully adjust the appropriate ANTENNA then MIXER coil for a maximum S-meter reading. The signal generator output should start at 60 db and be reduced as the circuit sensitivity increases.

**NOTE:** The coil cores are fragile. Tune them carefully from straight above. Be certain to tune the correct coil for each band.

**DRIVER COILS:**

Turn the H.SW switch to ON, turn the MODE switch to CW, set the METER switch to ALC, adjust the CAR control

to maximum, and set the standby switch to SEND. The SG switch should be OFF whenever the signal generator is connected to the transceiver. Adjust each coil, in the order of and at the frequencies described in Table 1, for maximum ALC deflection. Reduce the CAR control as necessary.

TABLE 1. ANTENNA, MIXER, and DRIVER Coil Adjustment

ORDER	BAND	FREQUENCY
1	3.5	3.750 MHz
2	28.5	28.800 MHz
3	21.0	21.225 MHz
4	14.0	14.175 MHz
5	7.0	7.150 MHz

### 3-14. WWV CIRCUIT ALIGNMENT

**PURPOSE:** To align the WWV circuit for maximum sensitivity.

**TEST EQUIPMENT:** Signal Generator.

**PROCEDURE:** Insert a 10 MHz, 60 db signal into the ANTENNA connector and push the WWV switch on. Set the main tuning dial to zero to receive the signal. Adjust coils T4 and T5 on the RF board for a maximum S-meter reading. Reduce the signal input as necessary. Adjust coil T3 for a maximum S-meter reading and then turn the core 1/4 turn counterclockwise.

### 3-15. IF TRANSFORMER ADJUSTMENT

**PURPOSE:** IF board and NB board alignment.

**TEST EQUIPMENT:** A signal generator and a voltmeter.

**PROCEDURE:** Insert a 40 db signal into the transceiver and receive it on USB at 14.175 MHz. Tune IF transformers T2, T5, T6, and T9 on the IF board (X48-1060-00) for a maximum S-meter reading. Then adjust IF transformers T1, T2, and T3 on the NB board (X54-1080-10) for a maximum S-meter reading. Figure 19 shows the coil locations.

Disconnect the coax from terminal OUT on the NB board and insert a 47 pf capacitor (as shown in Figure 18). Adjust T1 on the IF board and T4 and T5 on the NB board alternately for a maximum S-meter reading.

Remove the capacitor and reconnect the coax.

**NOTE:** Always repeat the adjustments several times because the coils affect each other.

Set the signal generator to 60 db and connect a voltmeter to the collector of Q6 on the NB board. Adjust NB IF coils T6 and T7 to minimize the voltage at the collector of Q6.



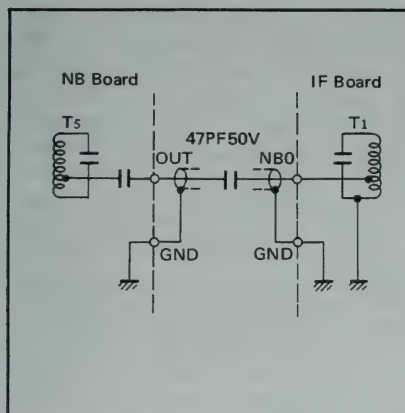


Figure 18. IF Transformer Test Circuit

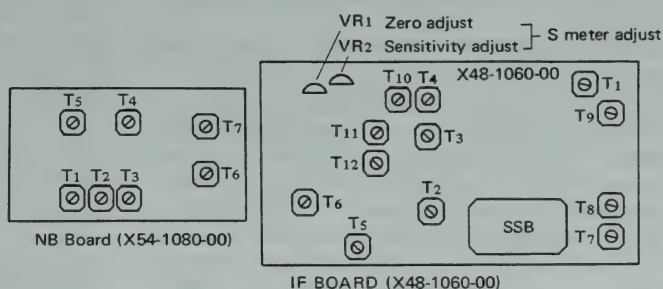


Figure 19. IF Transformer Adjustment Diagram

### 3-16. TRAP COIL ADJUSTMENT

**PURPOSE:** To align the trap coils.

**TEST EQUIPMENT:** Signal generator, an AF VTVM, and an 8 ohm dummy load.

**PROCEDURE:** Set the BAND switch to 7 MHz and insert an 8.895 MHz signal (70 db) at the ANTENNA connector. Tune the receiver to 7.0 MHz and adjust L11 on the RF board (X44-1080-00) for a minimum S-meter reading.

Set the signal generator to 8.395 MHz and tune the receiver to 7.5 MHz. Adjust L5 on the RF board to minimize the S-meter reading.

Turn the BAND switch to 3.5, turn the receiver to 3.7 MHz and adjust the DRIVE control for maximum sensitivity. Connect an AF VTVM and an 8 ohm dummy load to the EXT. SPEAKER jack of the TS-520. Insert a 3.736 MHz signal from the signal generator to the ANTENNA connector, tune it in on the VFO, and adjust trap coil L2 on the RF board for a minimum voltage reading on the AF VTVM.

### 3-17. CARRIER BALANCE

**PURPOSE:** To adjust the carrier balance.

**TEST EQUIPMENT:** A Signal generator, an 8 ohm dummy load, and an AF VTVM.

**PROCEDURE:** Tune the TS-520 to receive the signal generator input (20 db) at 14.175 MHz and adjust the DRIVE control for maximum sensitivity. Connect the AF VTVM and an 8 ohm dummy load to the EXT. SPEAKER jack. Adjust TC2 and VR3 (on the GENERATOR board) alternately for maximum voltage on the AF VTVM.

### 3-18. S-METER ADJUSTMENT

**PURPOSE:** To adjust the S-meter zero and sensitivity.

**TEST EQUIPMENT:** Signal generator.

**PROCEDURE:** Turn the RF gain control fully clockwise, receive the signal generator input at 14.175 MHz (40 db), and tune the DRIVE control for maximum sensitivity.

With no signal, adjust VR1 on the IF board (X48-1060-00) to zero the S-meter. Then with a 40 db signal to the ANTENNA connector at 14.175 MHz, adjust VR2 on the IF board for an S9 meter reading.

### 3-19. RIT ADJUSTMENT

**PURPOSE:** To adjust the RIT zero to the VFO frequency.

**TEST EQUIPMENT:** None required.

**PROCEDURE:** Set the RIT control to zero and push the RIT switch on. Turn the FUNCTION switch to CAL-25 KHz and receive a calibrator signal at any frequency. Adjust the VFO to receive the calibrator signal as a 1000 Hz tone.

Push the RIT switch off and adjust VR2 on the FIXED CH.-AVR board (X43-1100-00) for the same 1000 Hz tone established with the RIT on. Switch the RIT on and off several times to be certain that the two tones are identical.

### 3-20. CALIBRATOR FREQUENCY ADJUSTMENT

**PURPOSE:** To adjust the frequency of the built-in crystal calibrating circuit.

**TEST EQUIPMENT:** A frequency counter (or alternately use WWV as a frequency standard).

**PROCEDURE:** Connect a frequency counter to terminal MO of the MARKER board. Set the FUNCTION switch to CAL-25 KHz and adjust TC1 on the MARKER board for a frequency counter reading of an even 25 KHz ( $\pm 2$  Hz).

Alternately, connect an antenna to the transceiver and receive WWV at 10 MHz. Set the FUNCTION switch to CAL-25 KHz to turn on the calibrator. Adjust TC1, as above, to bring the calibrator; and WWV into a single beat note.

### 3-21. VFO ADJUSTMENT

**PURPOSE:** To adjust the frequency and output of the VFO circuit.

**TEST EQUIPMENT:** An RF VTVM and a frequency counter.

**PROCEDURE:** Set the FUNCTION switch to VFO and connect a frequency counter to terminal VFO on the IF board (X48-1060-00). With the VFO tuned to zero the frequency counter should read 5.5 MHz. If the frequency is not correct, adjust TC1 (inside the VFO section) as shown in Figure 20 for a correct frequency output. Tune the VFO to the 600 marking and check that the frequency counter shows 4.9 MHz. If the frequency is incorrect, adjust L1 in the VFO section for a proper frequency. Repeat the adjustment of TC1 and L1 alternately several times to insure proper operation.

To adjust the VFO output, set the VFO to 300, connect an RF VTVM to terminal V on the IF board, and adjust TC2 in the VFO section for a 0.9 volt reading.

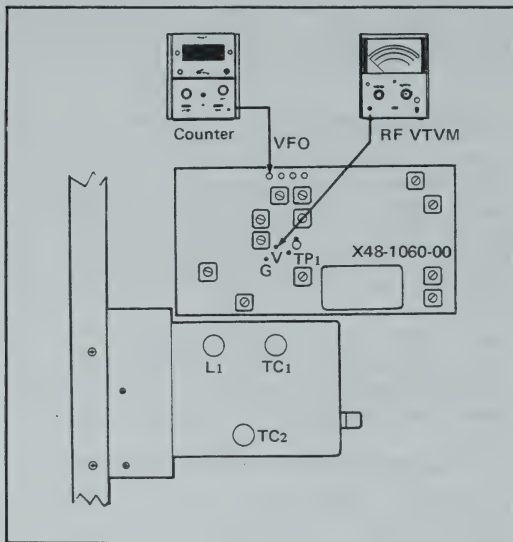


Figure 20. VFO Adjustment Diagram.

### 3-22. BIAS ADJUSTMENT

See the operating manual for instructions on setting the bias current to 60 ma. The bias requires readjustment if the AC line voltage is changed.

### 3-23. GENERATOR BOARD IF TRANSFORMER ADJUSTMENT

**PURPOSE:** To adjust the IF transformers on the GENERATOR board.

**TEST EQUIPMENT:** A 100 watt dummy load.

**PROCEDURE:** Slide the SG switch to off, turn the MODE switch to CW, set the METER switch to ALC, and

turn the CAR control fully clockwise. Tune the transmitter section at 14.175 MHz into the dummy load. The DRIVE control should be about 12 o'clock. Set the standby switch to SEND and adjust T1 on the GENERATOR board for a maximum ALC meter reading. Reduce the CAR control as necessary.

### 3-24. RF METER ADJUSTMENT

**PURPOSE:** To align the RF output meter reading and to verify the RF output level.

**TEST EQUIPMENT:** A 200 watt, 50 ohm RF dummy load, and a 200 watt, 3-30 MHz accurate RF wattmeter.

**PROCEDURE:** Tune the TS-520 for operation at 14.175 MHz into a dummy load through a wattmeter with the SG switch on. Set the meter switch to ALC and the CAR control to about 12 o'clock. With the MODE switch at TUN, transmit at 14.175 MHz and adjust the DRIVE control for a maximum ALC meter reading. Turn the METER switch to IP and tune the PLATE control to minimize the meter reading. Set the MODE switch to CW, turn the METER switch to RF, and tune the PLATE and LOAD controls alternately for maximum output power as indicated on the wattmeter. After the transceiver is tuned, adjust the side panel RF VOLT control for an RF meter reading of about 200 ma (on the IP scale). The RF meter position does not have a separate scale. Return the standby switch to REC.

Tune the TS-520 now for maximum CW output with the SG switch on. Check the power output at 3.75 MHz, 7.15 MHz, 14.175 MHz, 21.225 MHz, 28.3 MHz, 28.8 MHz, and 29.4 MHz. Verify with the wattmeter on each band that the output power meets specifications.

### 3-25. FINAL SECTION NEUTRALIZATION

**PURPOSE:** The TS-520 does not require matched final tubes, however when new finals are installed in the transceiver the final section must be reneutralized.

**TEST EQUIPMENT:** An RF VTVM and a dummy load.

**PROCEDURE:** Tune the TS-520 for maximum output on CW at 21.3 MHz with the SG switch on. Set the standby switch to REC and slide the SG switch off. Connect the RF VTVM to the ANTENNA connector along with the dummy load, and flip the standby switch to SEND. With an insulated tuning tool, tune TC1 in the final section for a minimum reading on the VTVM.

### 3-26. BALANCED MODULATOR AND CARRIER ADJUSTMENT

**PURPOSE:** To adjust the balanced modulator and the carrier.

**TEST EQUIPMENT:** An RF wattmeter, an AF VTVM, an AF signal generator, an RF VTVM, and a frequency counter, and a dummy load.

**PROCEDURE:** Tune the TS-520 for maximum CW output at 14.175 MHz through the wattmeter into a dummy load. Set the MODE switch to LSB, connect an RF VTVM to the ANTENNA connector and adjust TC1 and VR2 alternately



on the GENERATOR board for a minimum reading on the RF VTVM. Switch the MODE switch to USB and readjust TC1 and VR2 for an RF VTVM reading equal to the reading for LSB.

Disconnect the RF VTVM, set the MODE switch to LSB, and insert a 1500 Hz (5 mv) signal at the MIC connector. Adjust the MIC control for an output power of 50 watts. Switch the AF input to 400 Hz and, if necessary, adjust TC3 (on the CARRIER board) for an output power within 5 watts of the output for 1500 Hz. Switch the AF input to 2600 Hz and, if necessary, adjust TC3 for an output power within 5 watts of the output power for 1500 Hz.

Turn off the rear panel SG switch and connect a frequency counter to terminal OUT on the CARRIER board and set

the MODE switch to CW. Set the standby switch to SEND and adjust TC1 on the CARRIER board to obtain an oscillator frequency of 3.395 MHz.

### **3-27. SIDETONE OUTPUT ADJUSTMENT**

**PURPOSE:** To adjust the volume of the CW sidetone output to the speaker.

**TEST EQUIPMENT:** An AF VTVM and a telegraph key.

**PROCEDURE:** Slide the SG switch off and connect the key to the TS-520. Set the MODE switch to CW and the AF gain control to about 12 o'clock. Connect the AF VTVM to the EXT. SPEAKER jack, key the transceiver, and adjust VR2 on the AF board for a reading of about 50 mW (0.63 V/8 ohms).

---

# PARTS LIST

## ■ PARTS LIST OF TS-520 (Y54-1110-00)

Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
VC1	C03-0060-05	Variable capacitor (A) (FINAL)
VC2	C01-0084-05	Variable capacitor (B) (LOAD)
TC1	C03-0002-05	Neutralizing trimmer
C3	CC45CH2H101J	Ceramic 100pF ±5%
C4	CK45E2H102P	Ceramic 0.001μF +100% -0%
C7	CK45F2H103P	Ceramic 0.01μF +100% -0%
C8 ~ 13	CK45F1E403Z	Ceramic 0.04μF +80% -20%
C14	CK45E2H103P	Ceramic 0.01μF +100% -0%
C15	C90-0186-05	Ceramic 1000pF ±10%
C16	C90-0187-05	Ceramic 4700pF +100% -0%
C17	C45SL2H330J	Ceramic 33pF ±5%
C18	C90-0185-05	Ceramic 68pF ±5%
C19	C90-0184-05	Ceramic 47pF ±5%
C20	CC45SL2H271J	Ceramic 270pF ±5%
C21	CM91D3A681J	Mica 680pF ±5%
C22 ~ 26	CK45F1H103Z	Ceramic 0.01μF +80% -20%
C27, 28	C90-0180-05	Electrolytic block 22μF 45WV
C29, 30	CK45E2H103P	Ceramic 0.01μF +100% -0%
C31, 32	C90-0181-05	Electrolytic block 100μF 500WV
C33, 34	CE02W1E222	Electrolytic 2200μF 25WV
C35, 36	CK45F1E403Z	Ceramic 0.04μF +80% -20%
C37	CK45F1H103Z	Ceramic 0.01μF +80% -20%
C38	C90-0187-05	Ceramic 4700pF +100% -0%
C39	CK45F1H103Z	Ceramic 0.01μF +80% -20%
C40	C90-0187-05	Ceramic 4700pF +100% -0%
C41	CK45F1H103Z	Ceramic 0.01μF +80% -20%
C42	CE04W1C471	Electrolytic 470μF 16WV
C43, 44	CK45F1H103Z	Ceramic 0.01μF +80% -20%
<b>RESISTOR</b>		
R1	PD14BY2E103J	Carbon 10kΩ ±5% 1/4W
R2	PD05GF2H101K	Carbon 100Ω ±10% 1/4W
R3, 4	RC05GF3A100J	Carbon 10Ω ±5% 1W
R5	PD14BY2E332J	Carbon 3.3kΩ ±5% 1/4W
R6	RC05GF2H101K	Carbon 10kΩ ±10% 1/2W
R7	RC05GF3A103K	Carbon 10kΩ ±10% 1W
R8	PD14BY2E102J	Carbon 1kΩ ±5% 1/4W
R9	RC05GF2H560J	Carbon 56Ω ±5% 1/2W
R10, 11	RC05GF2H474J	Carbon 470kΩ ±5% 1/2W
R13	PD14BY2E332J	Carbon 3.3kΩ ±5% 1/4W
R14	PD14BY2E101J	Carbon 100Ω ±5% 1/4W
R15	RC05GF2H474J	Carbon 470kΩ ±5% 1/2W
R16, 17	PD14BY2E104J	Carbon 100kΩ ±5% 1/4W
VR1, 2	R08-3013-05	Potentiometer (MIC, CAR 10K(A) 10K(B))
VR3	R08-3012-15	Potentiometer (RF10K(B))
VR4	R01-4014-05	Potentiometer (BIS 50K(B))
VR5	R08-3012-05	Potentiometer (AF 10K(A))
VR6	R01-4014-05	Potentiometer (VOX, 50K(B))
VR7	R01-0040-05	Potentiometer (AVX 300(B))
VR8	R01-6009-05	Potentiometer (DELAY 250K(B))
VR9	R03-2004-05	Potentiometer (RIT 5K(B))
VR10	R01-3014-05	Potentiometer (RF, METER 10kΩM (B))
<b>TUBE/SEMICONDUCTOR</b>		
D3		Diode 1N60
D4, 5		Diode V06B
D6		Zener diode WZ-061
D7, 8		Diode 1S1555
V1, 2		Vacuum-tube S2001

Circuit No.	Parts No.	Description
<b>MISCELLANEOUS</b>		
—	A01-0211-02	Case
—	A10-0370-01	Chassis
—	A20-0699-05	Main chassis
—	A20-0700-13	Panel ass'y (England)
—	A20-0730-13	Panel ass'y (U.S.A., Europe)
—	A22-0135-12	Sub panel
—	A23-0429-02	Rear panel
—	A40-0120-11	Bottom plate
—	B05-0201-04	Speaker net
—	B10-0130-04	Front grass
—	B20-0287-04	Dial board
—	B30-0079-05	Pilot lamp (12V, 40mA) x 4
—	B31-0164-05	Meter
—	B40-0889-04	Name plate (U.S.A., Europe)
—	B40-0890-04	Name plate (England)
—	B41-0189-04	Voltage plate (120 ~ 240V) (U.S.A., England)
—	B41-0190-04	Voltage plate (120 ~ 220V) (Europe)
—	B42-0009-04	Passed sticker (Europe, England)
—	B42-0444-14	Switch name plate (England)
—	B42-0445-04	Panel name plate
—	B42-0446-04	Name plate of adjustment
—	B42-0447-04	VR name plate of adjustment
—	B42-0451-04	Fixed channel plate
—	B42-0452-04	DC terminal plate
—	B42-0474-14	Switch name plate (U.S.A., Europe)
—	B42-0287-04	Caution sticker (HIGH VOLTAGE)
—	B43-0200-04	Badge (TS-520)
—	B46-0047-00	Warranty card (U.S.A.)
—	B50-1101-00	Operating manual (U.S.A.)
—	B50-1102-00	Operating manual (Europe)
—	B50-1107-00	Operating manual (England)
—	B58-0181-00	Transmitter caution plate
—	D13-0032-04	Sprocket
—	D16-0033-04	Chain ass'y
—	D21-0324-05	Band shaft
—	D21-0326-04	Shaft (A) DRIVE
—	D21-0327-04	Shaft (B) PLATE
—	D21-0328-04	Shaft (C) LOAD
—	D22-0004-04	Shaft coupling
—	D22-0005-04	Shaft coupling
—	D22-0011-05	Shaft coupling
—	D23-0048-04	Bearing (metal)
—	D23-0061-04	Bearing (mold)
—	D23-0115-05	Ball bearing
—	D23-0116-05	Ball bearing ass'y
—	D32-0018-04	Shaft stopper
—	D32-0051-04	Shaft stopper
—	E01-0801-05	US socket
—	E01-0903-05	9P, MT socket
—	E03-0301-05	3P plug (Europe)
—	E04-0115-05	Receptacle, type-M
—	E05-0901-05	9P, MT plug
—	E06-0403-05	14P mike socket
—	E07-0403-05	14P mike plug
—	E08-0204-05	2P jack
—	E08-1202-05	12P jack
—	E08-1207-05	12P plug
—	E08-1208-05	12P connector (Socket)
—	E09-0204-05	2P plug



Circuit No.	Parts No.	Description
—	E11-0003-15	US jack
—	E110005-05	3P phone jack
—	E11-0034-05	US jack
—	E12-0001-05	Phone plug
—	E13-0101-05	1P pin jack
—	E14-0101-05	1P pin plug
—	E14-0801-05	US plug
—	E20-0512-05	5P terminal strips
—	E20-0513-05	5P terminal strips
—	E20-1003-05	10P terminal strips
—	E22-0206-05	Lug board
—	E22-0207-05	Lug board
—	E22-0214-05	Lug board
—	E22-0405-04	Lug board
—	E22-0603-04	Lug board
—	E23-0016-04	Lug board
—	E23-0037-04	Shaft grounding hardware
—	E30-0181-05	AC cord (U.S.A.)
—	E30-0214-05	Co-axial cable ass'y
—	E90-0004-15	Plate cap x 2
—	F05-2032-05	Fuse (20A)
—	F05-4022-05	Fuse (4A)
—	F05-6021-05	Fuse (6A)
—	F07-0315-13	Final cover
—	F10-0321-04	Coil pack shield plate
—	F10-0322-04	Relay shield plat
—	F11-0186-13	Final shield case
—	F15-0161-04	Shading plate
—	F19-0134-04	Side cover
—	G11-0008-04	Cushion
—	G11-0044-04	Cushion
—	H01-1014-04	Carton case (Inside) (England)
—	H01-1042-04	Carton case (Inside) (U.S.A., Europe)
—	H03-0283-04	Carton case (Outside) (U.S.A., Europe)
—	H03-0304-04	Carton case (Outside) (England)
—	H10-0570-04	Retainer
—	H10-0931-02	Polystyrene foamed fixture
—	H10-0932-02	Polystyrene foamed fixture
—	H10-0934-04	Protection board
—	H10-0964-04	Retainer
—	H20-0371-04	Protection cover
—	J02-0049-14	Leg (big)
—	J02-0022-05	Leg (small)
—	J13-0004-05	Fuse holder
—	J13-0037-05	Fuse holder (DC cord)
—	J19-0006-04	Switch stopper
—	J19-0360-04	Coupling holder
—	J21-0392-04	Lead holder
—	J21-0468-05	Angle (tank coil)
—	J21-0934-14	Handle holder
—	J21-1142-04	Meter mounting
—	J21-1143-04	VR mounting
—	J21-1144-04	Speaker mounting
—	J21-1145-04	Lamp stopper
—	J21-1146-04	Coil pack fixture
—	J21-1148-04	VC mounting fixture
—	J21-1149-22	IF board holding fixture
—	J21-1150-04	Indicator mounting fixture
—	J21-1151-04	Terminal strip retainer
—	J21-1155-04	Fixed-channel mounting fixture

Circuit No.	Parts No.	Description
—	J21-1202-04	Speaker mounting hardware ass'y
—	J29-0045-14	VR mounting reinforcement
—	J32-0074-04	Hexagonal boss x 8
—	J32-0081-04	Hexagonal boss x 4
—	J32-0127-04	Hexagonal boss
—	J32-0182-04	Hexagonal boss x 4
—	J32-0183-04	Hexagonal boss
—	J32-1030-14	Round boss
—	J41-0020-04	Knob bushing
—	J41-0024-15	Cord bushing
—	J59-0001-05	Grommet
—	J59-0002-05	Plunger
—	J61-0018-05	Beaded band
—	J61-0019-05	Wire wrapping band
—	J61-0036-05	Free-up belt
—	K01-0049-05	Knob
—	K21-0266-04	Knob
—	K21-0267-04	Knob x 5
—	K21-0268-04	Knob x 2
—	K21-0269-04	Knob x 3
—	K23-0270-04	Knob x 2
—	K23-0271-03	Knob
—	K29-0166-04	Knob x 2
—	K29-0167-23	Knob wafer
—	L01-0214-05	Power transformer
—	L15-0002-15	Choke coil
L3	L33-0098-05	Ferri-inductor
L4	L33-0101-05	Ferri-inductor
L5	L33-0032-05	Choke coil
L6	L33-0160-05	Final choke
L7	L31-0316-05	Final coil (B)
L8	L31-0142-05	Final coil (A)
L9	L33-0032-05	Choke coil
L10	L33-0101-05	Ferri-inductor
L11	L33-0110-05	Ferri-inductor
L12	L33-0098-05	Ferri-inductor
Ps1, 3	L33-0010-05	Parasitic suppressor
Ps3, 4	L39-0046-04	Parasitic suppressor
S1	S06-1006-05	Rotary switch (METER)
S2	S01-4017-05	Rotary switch (FUNCTION)
S3	S04-5016-05	Rotary switch (MODE)
S4	S29-1006-05	Rotary switch (CH SELECT)
S5	S10-1101-05	Rotary switch (FINAL)
S7	S31-2007-05	Slide switch
—	S40-2023-05	Push switch (RIT, WWV)
S10	S44-2018-05	Paddle switch
S11,13,14	S44-2016-05	Paddle switch
S15	S44-2015-05	Paddle switch
S16	S59-2020-05	See-saw switch (POWER)
S17	S59-2017-65	See-saw switch (VOLTAGE SELECT)
RL1	S51-4016-15	Relay
RL2	S51-4017-15	Relay (FINAL)
—	W01-0005-04	Adjusting ber
—	X40-0017-01	DRIVE coil unit
—	X40-0018-01	MIX coil unit
—	X40-0019-01	OSC coil unit
—	X40-1070-00	VFO unit
—	X43-1090-00	Rectifier unit
—	X43-1100-00	Fixed-channel, AVR unit

Circuit No.	Parts No.	Description
—	X43-1110-00	HV unit
—	X44-1080-00	RF unit
—	X44-1090-00	ANT coil unit
—	X46-1000-00	DC-DC converter unit
—	X48-1060-00	IF unit
—	X49-0008-01	AF unit
—	X50-0009-01	Carrier unit
—	X52-0005-01	Marker unit
—	X52-0010-01	Generator unit
—	X54-0001-00	VOX unit
—	X54-1080-10	NB unit
—	X54-1100-01	FAN unit
—	X54-1120-00	Indicator unit

Circuit No.	Parts No.	Description
L7	L33-0025-05	Choke coil
<b>MISCELLANEOUS</b>		
S3-1	S29-1005-05	Rotary wafer
S3-2	S29-1005-05	Rotary wafer
X1	L77-0141-05	Crystal oscillator (12,395MHz)
X2	L77-0142-05	Crystal oscillator (15,895MHz)
X3	L77-0143-05	Crystal oscillator (22,895MHz)
X4	L77-0144-05	Crystal oscillator (29,895MHz)
X5	L77-0145-05	Crystal oscillator (36,895MHz)
X6	L77-0146-15	Crystal oscillator (37,395MHz)
X7	L77-0147-05	Crystal oscillator (37,995MHz)

#### ■ PARTS LIST OF DRIVER COIL PACK (X40-0017-01)

Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
C1	CC45CH2H100J	Ceramic 10pF $\pm 5\%$
C2	CC45CH2H330J	Ceramic 33pF $\pm 5\%$
C3	CM93D2H151J(DM)	Mica 150pF $\pm 5\%$
C4	CC45CH2H330J	Ceramic 33pF $\pm 5\%$
C5, 6	CK45E2H103P	Ceramic 0.01 $\mu$ F +100% -0%
<b>RESISTOR</b>		
R1, 2	PD14BY2E151J	Carbon 150 $\Omega$ $\pm 5\%$ 1/4W
<b>COIL</b>		
L1	L31-0031-04	Tuning coil (3.5 MHz) (A)
L2	L31-0032-04	Tuning coil (7 MHz)
L3	L31-0033-04	Tuning coil (14 MHz)
L4	L31-0034-04	Tuning coil (21 MHz)
L5	L31-0209-04	Tuning coil
L6	L33-0097-05	Ferri-inductor
<b>MISCELLANEOUS</b>		
S1-1,1-2	S29-1052-05	Rotary wafer

#### ■ PARTS LIST OF MIX COIL UNIT (X40-0018-01)

Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
C1	CC45CH1H220J	Ceramic 22pF $\pm 5\%$
C2	CC45CH1H330J	Ceramic 33pF $\pm 5\%$
C3	CC45CH1H151J	Ceramic 150pF $\pm 5\%$
C4	CC45CH1H330J	Ceramic 33pF $\pm 5\%$
C5, 6	CK45E1H103P	Ceramic 0.01 $\mu$ F +100% -0%
<b>COIL</b>		
L1	L31-0036-04	Tuning coil (3.5MHz) (B)
L2	L31-0032-04	Tuning coil (7MHz)
L3	L31-0033-04	Tuning coil (14MHz)
L4	L31-0034-04	Tuning (21MHz)
L5	L31-0209-04	Tuning (28MHz)
L6	L33-0095-05	Ferri-inductor
<b>MISCELLANEOUS</b>		
S2-1,2-2	S29-1052-05	Rotary wafer

#### ■ PARTS LIST OF OSC COIL UNIT (X40-0019-00)

Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
C1	CC45CH1H121J	Ceramic 120pF $\pm 5\%$
C2	CC45CH1H680J	Ceramic 68pF $\pm 5\%$
C3	CC45CH1H560J	Ceramic 56pF $\pm 5\%$
C4	CC45CH1H100J	Ceramic 10pF $\pm 5\%$
C5 ~ 7	CK94YG1E403Z	Ceramic 0.04 $\mu$ F +80% -20%
<b>RESISTOR</b>		
R1	PD14BY2E102J	Carbon 1k $\Omega$ $\pm 5\%$ 1/4W
<b>COIL</b>		
L1, 2	L31-0032-04	Oscillator coil (3.5, 7MHz)
L3	L31-0033-04	Oscillator coil (14MHz)
L4	L32-0011-04	Oscillator coil (21MHz)
L5a,b	L32-0138-15	Oscillator coil (28MHz(A))
L6	L32-0012-04	Oscillator coil (28MHz(B))

#### ■ PARTS LIST OF VFO UNIT (X40-1070-00)

Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
C1	CC45PG1H470J	Ceramic 470pF $\pm 5\%$
C2,3	CC45LG1H150J	Ceramic 15pF $\pm 5\%$
C3	CC45CG1H150J	Ceramic 15pF $\pm 5\%$ Adjustment
C3	CC45PG1H150J	Ceramic 15pF $\pm 5\%$ Adjustment
C4	CC45SG1H070J	Ceramic 7pF $\pm 5\%$
C5	CC45LG1H470J	Ceramic 47pF $\pm 5\%$
C6	CC45LG1H220J	Ceramic 22pF $\pm 5\%$
C7,8	CM93F2A151J(DM)	Mica 150pF $\pm 5\%$
C9	CC45CH1H030D	Ceramic 3pF $\pm 0.5pF$
C10	CK45F1H203Z	Ceramic 0.02 $\mu$ F +80% -20%
C11,12	CK45F1E403Z	Ceramic 0.04 $\mu$ F +80% -20%



Circuit No.	Parts No.	Description
C13	CK45F1H203Z	Ceramic 0.02 $\mu$ F +80% -20%
C14	CC45SL1H330J	Ceramic 33pF $\pm$ 5%
C15	CC45SL1H050J	Ceramic 5pF $\pm$ 0.5pF
C16	CC45SL1H100D	Ceramic 10pF $\pm$ 0.5pF
C17	CC45SL1H050J	Ceramic 5pF $\pm$ 0.5pF
C18	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C19	CK45F1E403Z	Ceramic 0.04 $\mu$ F +80% -20%
C20	CC45CG1H100D	Ceramic 10pF $\pm$ 0.5pF
—	C01-0001-25	Variable capacitor
TC1	C03-0001-05	Variable capacitor
TC2	C05-0013-15	Ceramic trimmer

#### RESISTOR

R1	PD14BY2E274J	Carbon 270k $\Omega$ $\pm$ 5% 1/4W
R2	PD14BY2E101J	Carbon 100 $\Omega$ $\pm$ 5% 1/4W
R3, 4	PD14BY2E105J	Carbon 1 M $\Omega$ $\pm$ 5% 1/4W
R5	PD14BY2E331J	Carbon 330 $\Omega$ $\pm$ 5% 1/4W
R6	PD14BY2E333J	Carbon 33k $\Omega$ $\pm$ 5% 1/4W
R7	PD14BY2E473J	Carbon 47k $\Omega$ $\pm$ 5% 1/4W
R8	PD14BY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R9	PD14BY2E101J	Carbon 100 $\Omega$ $\pm$ 5% 1/4W

#### SEMICONDUCTOR

Q1		FET 3SK22(Y)
Q2		FET 2SK19(Y)
Q3, 4		Transistor 2SC460 (B)
D1		Diode SD111
D1, 2		Diode 1N60

#### MISCELLANEOUS

—	A01-0169-13	VFO case
—	B42-0010-04	Name plate
—	D22-0011-05	Shaft coupling
—	D40-0099-25	Gear mechanism
—	E13-0101-05	1P pin jack
—	E08-0204-05	2P receptacle
—	E22-0207-05	Lug board
—	E23-0021-04	Terminal
—	F07-0231-14	VFO cover
—	F10-0249-04	VFO shield plate
—	F11-0010-04	VFO box
—	J21-1157-03	VFO variable capacitor mounting hardware
—	J21-0895-03	VFO mounting hardware
L1	L32-0098-05	Oscillating coil
L2 ~ 4	L33-0104-05	Ferri-inductor
L5	L33-0091-05	Ferri-inductor
L6, 7	L33-0104-05	Ferri-inductor

### ■ PARTS LIST OF FIXED-CHANNEL AVR UNIT (X43-1100-00)

Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
C1	CC45SL1H151J	Ceramic 150pF $\pm$ 5%

Circuit No.	Parts No.	Description
C2	CK45F1E403Z	Ceramic 0.04 $\mu$ F +80% -20%
C3	CC45CH1H820J	Ceramic 82pF $\pm$ 5%
C4	CC45CH1H100J	Ceramic 10pF $\pm$ 5%
C5	CC45CH1H330J	Ceramic 33pF $\pm$ 5%
C6	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C7	CK45F1E403Z	Ceramic 0.04 $\mu$ F +80% -20%
C8	CE04W1C100(RL)	Electrolytic 10 $\mu$ F 16WV
C9	CE04W1C470(RL)	Electrolytic 47 $\mu$ F 16WV
C10	CE04W1HR47(RL)	Electrolytic 0.47 $\mu$ F 50WV
C11	CE04W1C101(RL)	Electrolytic 100 $\mu$ F 16WV
C12	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%

#### RESISTOR

R1	PD14CY2E222J	Carbon 2.2k $\Omega$ $\pm$ 5% 1/4W
R2	PD14CY2E473J	Carbon 47k $\Omega$ $\pm$ 5% 1/4W
R3	PD14CY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R4	PD14CY2E333J	Carbon 33k $\Omega$ $\pm$ 5% 1/4W
R5	PD14CY2E473J	Carbon 47k $\Omega$ $\pm$ 5% 1/4W
R6	PD14CY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R7	PD14CY2E101J	Carbon 100 $\Omega$ $\pm$ 5% 1/4W
R8	PD14CY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R9	PD14CY2E683J	Carbon 68k $\Omega$ $\pm$ 5% 1/4W
R10	PD14CY2E331J	Carbon 330 $\Omega$ $\pm$ 5% 1/4W
R11	PD14CY2E471J	Carbon 470 $\Omega$ $\pm$ 5% 1/4W
R12	PD14CY2E821J	Carbon 820 $\Omega$ $\pm$ 5% 1/4W
R13	PD14CY2E222J	Carbon 2.2k $\Omega$ $\pm$ 5% 1/4W
R14	PD14CY2E272J	Carbon 2.7k $\Omega$ $\pm$ 5% 1/4W
R15	PD14CY2E222J	Carbon 2.2k $\Omega$ $\pm$ 5% 1/4W
R16	PD14CY2E471J	Carbon 470 $\Omega$ $\pm$ 5% 1/4W
R17	PD14CY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R18	PD14CY2E392J	Carbon 3.9k $\Omega$ $\pm$ 5% 1/4W
R19	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
R20	PD14CY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R21	PD14CY2E471J	Carbon 470 $\Omega$ $\pm$ 5% 1/4W
R22	PD14CY2E151J	Carbon 150 $\Omega$ $\pm$ 5% 1/4W

#### SEMICONDUCTOR

Q1 ~ 3		Transistor 2SC460 (B)
Q4		Transistor 2SA606 (L)
Q5 ~ 7		Transistor 2SC372
Q8		Transistor 2SC735 (Y)
D1, 2		Diode 1N60
D3		Zener diode WZ-061
D4 ~ 7		Diode 1S1555
D8		Zener diode WZ-061

#### MISCELLANEOUS

—	E18-0401-05	Crystal socket
—	E23-0047-04	Terminal
L1	L33-0089-05	Ferri-inductor
L2 ~ 4	L33-0104-05	Ferri-inductor
T1	L12-0013-05	Oscillating transformer
VR1	R12-0042-05	Trimmer potentiometer
VR2	R12-3036-05	Trimmer potentiometer
VR3	R12-4020-05	Trimmer potentiometer
TC1 ~ 4	C05-0030-15	Ceramic trimmer 20pF
TC5	C05-0015-15	Ceramic trimmer 40pF

## ■ PARTS LIST OF RECTIFIER UNIT (X43-1090-00)

Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
C1, 2	CE02W2C330	Electrolytic tubler 33 $\mu$ F 160WV
<b>RESISTOR</b>		
D1 ~ 6		Diode (V08J)
D7		Diode (V06E)
D8 ~ 11		Diode (V06B)
R1 ~ 4	RC05GF2H474J	Carbon 470k $\Omega$ $\pm$ 5% 1/2W
R5, 6	RN14AB3D471J	Metal film 470 $\Omega$ $\pm$ 5% 2W
R7	RC05FG2H102J	Carbon 1k $\Omega$ $\pm$ 5% 1/2W
R8	RC05FG2H104	Carbon 100k $\Omega$ $\pm$ 5% 1/2W

## ■ PARTS LIST OF HV UNIT (X43-1110-00)

Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
C1	CK45E2H103P	Ceramic 0.01 $\mu$ F +100% -0%
<b>RESISTOR</b>		
R1	RC05GF2H104J	Carbon 100k $\Omega$ $\pm$ 5% 1/2W
R2 ~ 4	PD14BY2H684J	Carbon 680k $\Omega$ $\pm$ 5% 1/2W
R5, 6	RC05GF2H563J	Carbon 56k $\Omega$ $\pm$ 5% 1/2W

## ■ PARTS LIST OF RF UNIT (X44-1080-00)

Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
C1	CE04W1H010(RL)	Electrolytic 1 $\mu$ F 50W
C2	CE04W1HR47(RL)	Electrolytic 0.47 $\mu$ F 50WV
C3	CC45CH1H101J	Ceramic 100pF $\pm$ 5%
C4	CC45SL1H101J	Ceramic 100pF $\pm$ 5%
C5	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C6	CC45CH1H030D	Ceramic 3pF $\pm$ 0.5pF
C7	CC45SL1H330J	Ceramic 33pF $\pm$ 5%
C8, 9	CK45D1H102M	Ceramic 0.001 $\mu$ F $\pm$ 20%
C10, 11	CK45F1E403Z	Ceramic 0.04 $\mu$ F +80% -20%
C12	CM93D2H561J	Mica 560pF $\pm$ 5%
C13	CC45CH1H050D	Ceramic 5pF $\pm$ 0.5pF
C14	CK45F1E403Z	Ceramic 0.04 $\mu$ F +80% -20%
C15	CC45CH1H050D	Ceramic 5pF $\pm$ 0.5pF
C16	CC45CH1H101J	Ceramic 100pF $\pm$ 5%
C17, 18	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C19	CC45SL1H220J	Ceramic 22pF $\pm$ 5%
C20	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C21	CC45SL2H151J	Ceramic 150pF $\pm$ 5%
C22	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C23, 24	CK45D1H102M	Ceramic 0.001 $\mu$ F $\pm$ 20%
C25	CK45F1E403Z	Ceramic 0.04 $\mu$ F +80% -20%
C26	CC45CH1H100D	Ceramic 10pF $\pm$ 0.5pF
C27	CK45F1E403Z	Ceramic 0.04 $\mu$ F +80% -20%
C28	CC45SL1H101J	Ceramic 100pF $\pm$ 5%
C29 ~ 31	CK45E2H103P	Ceramic 0.01 $\mu$ F +100% -0%
C32, 33	CM93D2H561J	Mica 560pF $\pm$ 5%
C34	CK45B1H102K	Ceramic 0.001 $\mu$ F $\pm$ 10%
C35	CK45F1E403Z	Ceramic 0.04 $\mu$ F +80% -20%
C36	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%

Circuit No.	Parts No.	Description
C37	CK45E2H103P	Ceramic 0.01 $\mu$ F +100% -0%
C38	C90-0156-05	Metalized polyester film 0.047 $\mu$ F 250WV
C39	CK45E2H103P	Ceramic 0.01 $\mu$ F +100% -0%
C40	CC45SL1H330J	Ceramic 33pF $\pm$ 5%
C41	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C42	CC45CH1H020D	Ceramic 2pF $\pm$ 0.5pF
C43	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C44 ~ 46	CK45F1F403Z	Ceramic 0.04 $\mu$ F +80% -20%
C48	C90-0154-05	Metalized polyester film 0.22 $\mu$ F 250WV
C49	CK45D1H102M	Ceramic 0.001 $\mu$ F $\pm$ 20%
C50	CQ93M1H473K	Electrolytic mylar 0.047 $\mu$ F $\pm$ 10%
C51	CC45CH1H101J	Ceramic 100pF $\pm$ 5%
C52	CK45E2H103P	Ceramic 0.01 $\mu$ F +100% -0%
C53	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C54	CC45CH1H101J	Ceramic 100pF $\pm$ 5%
C55	CC45CH1H050D	Ceramic 5pF $\pm$ 0.5pF
VC1 ~ 3	C01-0127-05	Variable capacitor
<b>RESISTOR</b>		
R1	PD14CY2E274J	Carbon 270k $\Omega$ $\pm$ 5% 1/4W
R2	PD14CY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R3	RC05GF2H225J	Carbon 2.2M $\Omega$ $\pm$ 5% 1/2W
R4	PD14CY2E333J	Carbon 33k $\Omega$ $\pm$ 5% 1/4W
R5	PD14CY2E471J	Carbon 470 $\Omega$ $\pm$ 5% 1/4W
R6	PD14CY2E333J	Carbon 33k $\Omega$ $\pm$ 5% 1/4W
R7	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
R8	PD14CY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R9	PD14CY2E101J	Carbon 100 $\Omega$ $\pm$ 5% 1/4W
R10	PD14CY2E104J	Carbon 100k $\Omega$ $\pm$ 5% 1/4W
R11	PD14CY2E474J	Carbon 470k $\Omega$ $\pm$ 5% 1/4W
R12	PD14CY2E124J	Carbon 120k $\Omega$ $\pm$ 5% 1/4W
R13	PD14CY2E274J	Carbon 270k $\Omega$ $\pm$ 5% 1/4W
R14	PD14CY2E104J	Carbon 100k $\Omega$ $\pm$ 5% 1/4W
R15, 16	PD14CY2E560J	Carbon 56 $\Omega$ $\pm$ 5% 1/4W
R17	PD14CY2E181J	Carbon 180 $\Omega$ $\pm$ 5% 1/4W
R18, 19	PD14CY2E682J	Carbon 6.8k $\Omega$ $\pm$ 5% 1/4W
R20	PD14CY2E101J	Carbon 100 $\Omega$ $\pm$ 5% 1/4W
R21	PD14CY2E271J	Carbon 270 $\Omega$ $\pm$ 5% 1/4W
R22	PD14CY2E184J	Carbon 180k $\Omega$ $\pm$ 5% 1/4W
R23	PD14CY2E104J	Carbon 100k $\Omega$ $\pm$ 5% 1/4W
R24, 25	PD14CY2E560J	Carbon 56 $\Omega$ $\pm$ 5% 1/4W
R26	PD14CY2E101J	Carbon 100 $\Omega$ $\pm$ 5% 1/4W
R27, 28	PD14CY2E104J	Carbon 100k $\Omega$ $\pm$ 5% 1/4W
R29	PD14CY2E561J	Carbon 560 $\Omega$ $\pm$ 5% 1/4W
R30	PD14CY2E182J	Carbon 1.8k $\Omega$ $\pm$ 5% 1/4W
R31	PD14CY2E560J	Carbon 56 $\Omega$ $\pm$ 5% 1/4W
R32	PD14CY2E105J	Carbon 1 M $\Omega$ $\pm$ 5% 1/4W
R33	RC05GF2H820J	Carbon 82 $\Omega$ $\pm$ 5% 1/2W
R34, 35	RC05GF2H330J	Carbon 33 $\Omega$ $\pm$ 5% 1/2W
R35	RC05GF2H330J	Carbon 33 $\Omega$ $\pm$ 5% 1/2W
R36	PD14CY2E474J	Carbon 470k $\Omega$ $\pm$ 5% 1/4W
R37, 28	PD14CY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R39, 40	PD14CY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R41	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
R42, 43	PD14CY2E392J	Carbon 3.9k $\Omega$ $\pm$ 5% 1/4W
R44	PD14CY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R45	PD14CY2E392J	Carbon 3.9k $\Omega$ $\pm$ 5% 1/4W
R46	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
R47	PD14CY2E392J	Carbon 3.9k $\Omega$ $\pm$ 5% 1/4W
R48	PD14CY2E682J	Carbon 6.8k $\Omega$ $\pm$ 5% 1/4W
R49	PD14CY2E563J	Carbon 56k $\Omega$ $\pm$ 5% 1/4W
R50	PD14CY2E104J	Carbon 100k $\Omega$ $\pm$ 5% 1/4W



Circuit No.	Parts No.	Description
R51	PD14CY2E153J	Carbon 15k $\Omega$ $\pm 5\%$ 1/4W
R52	PD14CY2E683J	Carbon 68k $\Omega$ $\pm 5\%$ 1/4W
R53	PD14CY2E123J	Carbon 12k $\Omega$ $\pm 5\%$ 1/4W
R54	PD14CY2E473J	Carbon 47k $\Omega$ $\pm 5\%$ 1/4W
R55	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm 5\%$ 1/4W
R56	PD14CY2E273J	Carbon 27k $\Omega$ $\pm 5\%$ 1/4W
R57	PD14CY2E822J	Carbon 8.2k $\Omega$ $\pm 5\%$ 1/4W
R59	PD14CY2E333J	Carbon 33k $\Omega$ $\pm 5\%$ 1/4W
R60	PD14CY2E104J	Carbon 100k $\Omega$ $\pm 5\%$ 1/4W
R61	PD14CY2E102J	Carbon 1k $\Omega$ $\pm 5\%$ 1/4W
R62	PD14CY2E471J	Carbon 470 $\Omega$ $\pm 5\%$ 1/4W
R63	PD14CY2E104J	Carbon 100k $\Omega$ $\pm 5\%$ 1/4W
R64	PD14CY2E332J	Carbon 3.3k $\Omega$ $\pm 5\%$ 1/4W
R65 ~ 67	PD14CY2E101J	Carbon 100 $\Omega$ $\pm 5\%$ 1/4W
R68	PD14CY2E103J	Carbon 10k $\Omega$ $\pm 5\%$ 1/4W
R69	PD14CY2E331J	Carbon 330 $\Omega$ $\pm 5\%$ 1/4W
R70	RC05GF2H823J	Carbon 82k $\Omega$ $\pm 5\%$ 1/2W
R71	RC05GF2H392J	Carbon 3.9k $\Omega$ $\pm 5\%$ 1/2W
R72	PD14BY2B563J	Carbon 56k $\Omega$ $\pm 5\%$ 1/8W

#### SEMICONDUCTOR

Q1	FET 2SK19(GR)
Q2	Transistor 2SC460(B)
Q3	FET 3SK41(L)
Q4	FET 3SK35(GR)
Q5	FET 3SK35(Y)
Q6	Transistor 2SC733(Y)
Q7	Transistor 2SC535(A)
Q8	FET 3SK22(GR)
Q9	FET 2SK19(GR)
Q10	Transistor 2SC856
Q11	FET 3SK35(GR)
D1	Zener diode WZ-090
D2 ~ 4	Diode 1S73A
D5, 6	Diode V06B
D7, 8	Zener diode WZ-090
D9	Diode 1S1555

#### MISCELLANEOUS

—	D13-0032-03	Sprocket x 3
—	D16-0033-04	Chain ass'y x 2
—	E06-0406-05	FET socket x 4
—	E10-1902-05	Vacuum-tube socket
—	E23-0046-04	Terminal
—	E23-0047-04	Terminal
—	F11-0020-05	Shield case
T1, 2	L30-0008-05	B.P.F. coil
T3	L32-0165-05	OSC coil
T4, 5	L31-0317-05	Tuning coil
L1	L33-0104-05	Ferri-inductor
L2	L31-0012-05	Trap coil (12,395 MHz)
L3	L33-0104-05	Ferri-inductor
L4	L33-0098-05	Ferri-inductor
L5	L31-0010-05	Trap coil (8.6 MHz)
L6	L33-0098-05	Ferri-inductor
L7	L33-0074-05	Heater choke
L8	L33-0104-05	Ferri-inductor
L10	L33-0131-05	Ferri-inductor
L11	L31-0011-05	Trap coil (8.6 MHz)
X1	L77-0013-35	Crystal oscillator

### ■ PARTS LIST OF ANT COIL UNIT (X44-1090-00)

Circuit No.	Parts No.	Description
V1		Vacuum-tube 12BY7A
<b>CAPACITOR</b>		
C1	CC45CH1H270J	Ceramic 27pF $\pm 5\%$
C2	CC45CH1H151J	Ceramic 150pF $\pm 5\%$
C3	CC45CH1H330J	Ceramic 33pF $\pm 5\%$
C4	CC45CH1H220J	Ceramic 22pF $\pm 5\%$
<b>COIL</b>		
L1	L31-0031-04	Tuning coil 3.5 MHz
L2	L31-0032-04	Tuning coil 7 MHz
L3	L31-0033-04	Tuning coil 14 MHz
L4	L31-0034-04	Tuning coil 21 MHz
L5	L31-0209-04	Tuning coil 28 MHz
<b>MISCELLANEOUS</b>		
—	E23-0015-04	Grounding lug
—	J31-0102-04	Collar A
—	J31-0103-04	Collar B
—	J31-0105-04	Collar D
—	J32-0184-04	Screw rod
—	S29-1052-05	Rotary wafer

### ■ PARTS LIST OF DC-DC CONVERTER UNIT (X46-1000-00)

Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
C1	CE02W1E221	Electrolytic 220 $\mu$ F 25WV
<b>SEMICONDUCTOR</b>		
Q1, 2		Transistor 2N4049
R1	R92-0121-05	Cement 2.4 $\Omega$ 5W
R2	R92-0120-05	Cement 220 $\Omega$ 2W
<b>MISCELLANEOUS</b>		
—	E20-0510-05	5P terminal strips
—	F01-0170-04	Heat sink (A)
—	F01-0171-04	Heat sink (B)
—	F11-0195-04	Heat sink cover

### ■ PARTS LIST OF IF UNIT (X48-1060-00)

Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
C1	CC45SL1H330J	Ceramic 33pF $\pm 5\%$
C2	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm 10\%$
C3	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C4	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm 10\%$
C5	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C6	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm 10\%$
C7, 8	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C9	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm 10\%$
C10	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%

Circuit No.	Parts No.	Description
C11	CK45D1H102M	Ceramic 0.001 $\mu$ F $\pm$ 20%
C12	CC45SL1H220J	Ceramic 22pF $\pm$ 5%
C13	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C14	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C15	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C16	CC45SL1H101J	Ceramic 100pF $\pm$ 5%
C17	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C18	CC45SL1H050D	Ceramic 5pF $\pm$ 0.5pF
C19	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C20	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C21	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C22	CC45CH1H121J	Ceramic 120pF $\pm$ 5%
C23	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C24	CC45CH1H330J	Ceramic 33pF $\pm$ 5%
C25	CC45SL1H151J	Ceramic 150pF $\pm$ 5%
C27	CE04W1H010(RL)	Electrolytic 1 $\mu$ F 50WV
C28	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C29	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C30	CK45D1H102M	Ceramic 0.001 $\mu$ F $\pm$ 20%
C31	CC45SL1H221J	Ceramic 220pF $\pm$ 5%
C32	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C33	CC45SL1H470J	Ceramic 47pF $\pm$ 5%
C34	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C35	CC45SL1H100D	Ceramic 10pF $\pm$ 0.5pF
C36	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C37	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C38	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C39	CC45SL1H101J	Ceramic 100pF $\pm$ 5%
C40	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C41, 42	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C43, 44	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C45, 46	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C47, 48	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C49	CC45CH1H101J	Ceramic 100pF $\pm$ 5%
C50	CC45SL1H101J	Ceramic 100pF $\pm$ 5%
C51	CC45CH1H330J	Ceramic 33pF $\pm$ 5%
C53	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C54	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C55, 56	CC45SL1H101J	Ceramic 100pF $\pm$ 5%
C57, 58	CC45SL1H331J	Ceramic 330pF $\pm$ 5%
C59, 60	CC45SL1H330J	Ceramic 33pF $\pm$ 5%

#### RESISTOR

R1	PD14CY2E222J	Carbon 2.2k $\Omega$ $\pm$ 5% 1/4W
R2	PD14CY2E221J	Carbon 220 $\Omega$ $\pm$ 5% 1/4W
R3	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
R4	PD14CY2E221J	Carbon 220 $\Omega$ $\pm$ 5% 1/4W
R5	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
R6	PD14CY2E223J	Carbon 22k $\Omega$ $\pm$ 5% 1/4W
R7	PD14CY2E221J	Carbon 220 $\Omega$ $\pm$ 5% 1/4W
R8	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
R9	PD14CY2E221J	Carbon 220 $\Omega$ $\pm$ 5% 1/4W
R10	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
R11	PD14CY2E223J	Carbon 22k $\Omega$ $\pm$ 5% 1/4W
R12	PD14CY2E222J	Carbon 2.2 $\Omega$ $\pm$ 5% 1/4W
R13	PD14CY2E473J	Carbon 47k $\Omega$ $\pm$ 5% 1/4W
R14	PD14CY2E123J	Carbon 12k $\Omega$ $\pm$ 5% 1/4W
R15	PD14CY2E473J	Carbon 47k $\Omega$ $\pm$ 5% 1/4W
R16	PD14CY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R17	PD14CY2E101J	Carbon 100 $\Omega$ $\pm$ 5% 1/4W
R18	PD14CY2E474J	Carbon 470k $\Omega$ $\pm$ 5% 1/4W
R19	PD14CY2E473J	Carbon 47k $\Omega$ $\pm$ 5% 1/4W
R20	PD14CY2E822J	Carbon 8.2k $\Omega$ $\pm$ 5% 1/4W
R21	PD14CY2E473J	Carbon 47k $\Omega$ $\pm$ 5% 1/4W
R22	PD14CY2E224J	Carbon 220k $\Omega$ $\pm$ 5% 1/4W

Circuit No.	Parts No.	Description
R23	PD14CY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R24	PD14CY2E332J	Carbon 3.3k $\Omega$ $\pm$ 5% 1/4W
R25, 26	PD14CY2E471J	Carbon 470 $\Omega$ $\pm$ 5% 1/4W
R27	PD14CY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R28	RC05GF2H225J	Carbon 2.2M $\Omega$ $\pm$ 5% 1/2W
R29	PD14CY2E222J	Carbon 2.2k $\Omega$ $\pm$ 5% 1/4W
R30	PD14CY2E101J	Carbon 100 $\Omega$ $\pm$ 5% 1/4W
R31	PD14CY2E224J	Carbon 220k $\Omega$ $\pm$ 5% 1/4W
R32	PD14CY2E101J	Carbon 100 $\Omega$ $\pm$ 5% 1/4W
R33	PD14CY2E471J	Carbon 470 $\Omega$ $\pm$ 5% 1/4W
R34	PD14CY2E473J	Carbon 47k $\Omega$ $\pm$ 5% 1/4W
R35	PD14CY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R36	PD14CY2E101J	Carbon 100 $\Omega$ $\pm$ 5% 1/4W
R37	PD14CY2E473J	Carbon 47k $\Omega$ $\pm$ 5% 1/4W
R38	PD14CY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R39	PD14BY2B471J	Carbon 470 $\Omega$ $\pm$ 5% 1/8W
R40	PD14CY2E821J	Carbon 820 $\Omega$ $\pm$ 5% 1/4W
R41	PD14CY2E273J	Carbon 27k $\Omega$ $\pm$ 5% 1/4W
R42	PD14CY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R43, 44	PD14CY2E104J	Carbon 100k $\Omega$ $\pm$ 5% 1/4W
R45	PD14CY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R46	PD14CY2E152J	Carbon 1.5k $\Omega$ $\pm$ 5% 1/4W
R47	PD14CY2E104J	Carbon 100k $\Omega$ $\pm$ 5% 1/4W
R48	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
R49	PD14CY2E471J	Carbon 470 $\Omega$ $\pm$ 5% 1/4W
R50	PD14CY2E331J	Carbon 330 $\Omega$ $\pm$ 5% 1/4W
R51	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
R52	PD14CY2E561J	Carbon 560 $\Omega$ $\pm$ 5% 1/4W

#### SEMICONDUCTOR

D1 ~ 4	Diode	1S73A
D5, 6	Diode	1N60
D7	Diode	1S1555
D9, 10	Diode	1S1555
D11	Diode	WZ-090
Q1	FET	3SK35(GR)
Q2	FET	3SK41(L)
Q3,4	FET	3SK35(GR)
Q5,6	Transistor	2SC733(Y)
Q7	FET	2SK19(GR)
Q8	Transistor	2SA495(Y)
Q9	FET	3SK35(GR)

#### COIL

T1	L30-0263-05	IFT
T2	L30-0010-05	IFT
T3	L30-0008-05	B.P.F. coil
T4	L30-0009-05	B.P.F. coil
T5	L30-0010-05	IFT
T6	L30-0021-05	IFT
T7	L30-0009-05	B.P.F. coil
T8	L30-0008-05	B.P.F. coil
T9	L30-0010-05	IFT
T10	L31-0284-05	Filter coil (BLU)
T11	L31-0252-05	Filter coil (GRN)
T12	L31-0251-05	Filter coil (WHT)
L1 ~ 6	L33-0104-05	Ferri-inductor
XF1	L71-0018-05	Crystal oscillator

#### MISCELLANEOUS

VR1	R12-3025-05	Trimmer potentiometer 10k(B)
VR2	R12-7013-05	Trimmer potentiometer 500k(B)



## ■ PARTS LIST AF UNIT (X49-0008-01)

Circuit No.	Parts No.	Description.
<b>CAPACITOR</b>		
C1	CE04W1H010(RL)	Electrolytic 1 $\mu$ F 50WV
C2	CE04W0J101(RL)	Electrolytic 100 $\mu$ F 6.3WV
C3	CE04W1C101(RL)	Electrolytic 100 $\mu$ F 16WV
C4	CE04W1E100(RL)	Electrolytic 10 $\mu$ F 25WV
C5	CQ93M1H472K	Mylar 0.0047 $\mu$ F $\pm$ 10%
C6	CE04W0F470(RL)	Electrolytic 47 $\mu$ F 3.15WV
C7	CE04W1C330(RL)	Electrolytic 33 $\mu$ F 16WV
C8	CE04W1C221(RL)	Electrolytic 220 $\mu$ F 16WV
C9	CK45F1E103Z	Ceramic 0.01 $\mu$ F +80% -20%
C10	CC94SL1H101K	Ceramic 100pF $\pm$ 10%
C11	CK45F1E103Z	Ceramic 0.01 $\mu$ F +80% -20%
C12	CE04W1H010(RL)	Electrolytic 1 $\mu$ F 50WV
C13	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C14	CE04W1HR47	Electrolytic 0.47 $\mu$ F 50WV
C15	CQ92M1H103K	Mylar 0.01 $\mu$ F $\pm$ 10%
C16, 17	CE04W1E100(RL)	Electrolytic 10 $\mu$ F 25WV
C18	CK45B1H331K	Ceramic 330pF $\pm$ 10%
C19	CE04W1E100(RL)	Electrolytic 10 $\mu$ F 25WV
C20	CE04W1E3R3(RL)	Electrolytic 3.3 $\mu$ F 25WV
C21	CE04W1E100(RL)	Electrolytic 10 $\mu$ F 25WV
C22 ~ 25	CQ93M1H123K	Mylar 0.012 $\mu$ F $\pm$ 10%
C26	CK45F1E203Z	Ceramic 0.02 $\mu$ F +80% -20%
C27, 28	CK45F1E103Z	Ceramic 0.01 $\mu$ F +80% -20%
<b>RESISTOR</b>		
R1	PD14BY2E223J	Carbon 22k $\Omega$ $\pm$ 5% 1/4W
R2	PD14BY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R3	PD14BY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R4	PD14CY2E471J	Carbon 470 $\Omega$ $\pm$ 5% 1/4W
R5	PD14BY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R6	PD14BY2E152J	Carbon 1.5k $\Omega$ $\pm$ 5% 1/4W
R7	PD14BY2E221J	Carbon 220 $\Omega$ $\pm$ 5% 1/4W
R8	PD14BY2E471J	Carbon 470 $\Omega$ $\pm$ 5% 1/4W
R9	PD14BY2E330J	Carbon 33 $\Omega$ $\pm$ 5% 1/4W
R10	PD14BY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R11, 12	R92-0041-25	Metal plate 0.47 $\Omega$ $\pm$ 10% 1W
R13	PD14BY2E682J	Carbon 6.8k $\Omega$ $\pm$ 5% 1/4W
R14	PD14CY2E473J	Carbon 47k $\Omega$ $\pm$ 5% 1/4W
R15	PD14BY2E682J	Carbon 6.8k $\Omega$ $\pm$ 5% 1/4W
R16	PD14BY2E332J	Carbon 3.3k $\Omega$ $\pm$ 5% 1/4W
R17	PD14CY2E273J	Carbon 27k $\Omega$ $\pm$ 5% 1/4W
R18	PD14BY2E562J	Carbon 5.6k $\Omega$ $\pm$ 5% 1/4W
R19	PD14BY2E221J	Carbon 220 $\Omega$ $\pm$ 5% 1/4W
R20	PD14BY2E392J	Carbon 3.9k $\Omega$ $\pm$ 5% 1/4W
R21	PD14BY2E222J	Carbon 2.2k $\Omega$ $\pm$ 5% 1/4W
R22	PD14BY2E821J	Carbon 820 $\Omega$ $\pm$ 5% 1/4W
R23	PD14BY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R24	PD14CY2E562J	Carbon 5.6k $\Omega$ $\pm$ 5% 1/4W
R25	PD14CY2E474J	Carbon 470k $\Omega$ $\pm$ 5% 1/4W
R26	PD14CY2E104J	Carbon 100k $\Omega$ $\pm$ 5% 1/4W
R27	PD14BY2E223J	Carbon 22k $\Omega$ $\pm$ 5% 1/4W
R28	PD14BY2E224J	Carbon 220k $\Omega$ $\pm$ 5% 1/4W
R29	PD14BY2E104J	Carbon 100k $\Omega$ $\pm$ 5% 1/4W
R30	PD14BY2E332J	Carbon 3.3k $\Omega$ $\pm$ 5% 1/4W
R31	PD14BY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R32 ~ 34	PD14CY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R35	PD14BY2E105J	Carbon 1M $\Omega$ $\pm$ 5% 1/4W
R36	PD14BY2E224J	Carbon 220k $\Omega$ $\pm$ 5% 1/4W
R37	PD14CY2E222J	Carbon 2.2k $\Omega$ $\pm$ 5% 1/4W
R38	PD14CY2E120J	Carbon 12 $\Omega$ $\pm$ 5% 1/4W
<b>SEMICONDUCTOR</b>		
D1, 2		Diode 1N60
D3		Diode 1S1555

Circuit No.	Parts No.	Description
D4		Zener diode WZ130
D5		Diode V06B
Q1		Transistor 2SC733(Y)
Q2		Transistor 2SC734(Y)
Q3		Transistor 2SD90(O) red
Q4		Transistor 2SB473(C,D,N)
Q5		Transistor 2SC1000(GR)
Q6		Transistor 2SC733(Y)
<b>MISCELLANEOUS</b>		
—	F01-0074-24	Heat sink x 2
L		
L1	L33-0032-05	Choke coil
—	L33-0088-05	Ferri-inductor
VR1	R12-4015-05	Trimmer potentiometer

## ■ PARTS LISTS OF CARRIER UNIT (X50-009-01)

Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
C1	CK94YG1E102Z	Ceramic 0.001 $\mu$ F +80% -20%
C2	CC45CH1H220J	Ceramic 22pF $\pm$ 5%
C3	CK94YG1E102Z	Ceramic 0.001 $\mu$ F +80% -20%
C4	CC45CH1H220J	Ceramic 22pF $\pm$ 5%
C5	CK94YG1E102Z	Ceramic 0.001 $\mu$ F +80% -20%
C6	CC45CH1H220J	Ceramic 22pF $\pm$ 5%
C7	CK94YG1E102Z	Ceramic 0.001 $\mu$ F +80% -20%
C8	CK94YX1H471K	Ceramic 470pF $\pm$ 10%
C9	CC94TH1H221J	Ceramic 220pF $\pm$ 5%
C10	CC94SL1H101K	Ceramic 100pF $\pm$ 10%
C11	CC45CH1H100J	Ceramic 10pF $\pm$ 5%
C12	CK94YG1E403Z	Ceramic 0.04 $\mu$ F +80% -20%
C13	CC45CH1H220J	Ceramic 22pF $\pm$ 5%
C14	CK94YG1E103Z	Ceramic 0.01 $\mu$ F +80% -20%
<b>RESISTOR</b>		
R1 ~ 4	PD14BY2E682J	Carbon 6.8k $\Omega$ $\pm$ 5% 1/4W
R5	PD14BY2E333J	Carbon 33k $\Omega$ $\pm$ 5% 1/4W
R6	PD14BY2E682J	Carbon 6.8k $\Omega$ $\pm$ 5% 1/4W
R7	PD14BY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R8	PD14BY2E683J	Carbon 68k $\Omega$ $\pm$ 5% 1/4W
R9	PD14BY2E101J	Carbon 100 $\Omega$ $\pm$ 5% 1/4W
<b>SEMICONDUCTOR</b>		
D1 ~ 4		Diode 1S1555
Q1, 2		Transistor 2SC460(B)
<b>MISCELLANEOUS</b>		
L1 ~ 6	L33-0104-05	Ferri-inductor
T1	L32-0003-05	Oscillating coil
TC1 ~ 3	C05-0013-15	Ceramic trimmer
X1	L77-0123-05	Crystal oscillator
X2	L77-0122-05	Crystal oscillator
X3	L77-0120-05	Crystal oscillator

## ■ PARTS LIST OF MARKER UNIT (X52-0005-01)

Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
C1	CQ93M1H103K	Mylar 0.01 $\mu$ F $\pm$ 10%
C2	CC45CH1H151J	Ceramic 150pF $\pm$ 5%
C3	CC94TH2H101J	Ceramic 100pF $\pm$ 5%
C4	CC45CH1H330J	Ceramic 33pF $\pm$ 5%
C5	CK94YG1E403Z	Ceramic 0.04 $\mu$ F +80% -20%
C6	CC45CH1H390J	Ceramic 39pF $\pm$ 5%
C7	CC45CH1H330J	Ceramic 33pF $\pm$ 5%
C8	CC45CH1H820J	Ceramic 82pF $\pm$ 5%
C9	CC45CH1H201J	Ceramic 200pF $\pm$ 10%
C10	CC94SL1H470K	Ceramic 47pF $\pm$ 10%
C11	CC94SL2H050D	Ceramic 5pF $\pm$ 0.5pF
C12	CK94YG1E403Z	Ceramic 0.04 $\mu$ F +80% -20%
C13	CC45CH1H470J	Ceramic 47pF $\pm$ 5%
<b>RESISTOR</b>		
R1	PD14CY2E473J	Carbon 47k $\Omega$ $\pm$ 5% 1/4W
R2	PD14CY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R3	PD14CY2E101J	Carbon 100 $\Omega$ $\pm$ 5% 1/4W
R4	PD14CY2E473J	Carbon 47k $\Omega$ $\pm$ 5% 1/4W
R5	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
R6	PD14CY2E224J	Carbon 220k $\Omega$ $\pm$ 5% 1/4W
R7	RC05GF2H105J	Carbon 1M $\Omega$ $\pm$ 5% 1/2W
R8 ~ 10	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
<b>SEMICONDUCTOR</b>		
Q1		Transistor 2SC373 or 2SC458 (B)
Q2, 3		Transistor 2SC373
Q4		Transistor 2SC373 or 2SC458 (B)
D1		Diode 1N60
L1	L33-0118-05	Ferri-inductor
X1	L77-0009-05	Crystal oscillator
-	J19-0013-04	Crystal oscillator holder
-	C05-0029-15	Ceramic trimmer

## ■ PARTS LISTS OF GENERATOR UNIT (X52-0010-01)

Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
C1, 2	CC94SL1H101K	Ceramic 100pF $\pm$ 10%
C3	CK45F1E103Z	Ceramic 0.01 $\mu$ F +80% -20%
C4	CE04W1E4R7	Electrolytic 4.7 $\mu$ F 25WV
C5	CE04W1H010	Electrolytic 1 $\mu$ F 50WV
C6	CK45F1E502Z	Ceramic 0.005 $\mu$ F +80% -20%
C7	CE04W1C470(RL)	Electrolytic 47 $\mu$ F 16WV
C8	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C9	CE04W1H010	Electrolytic 1 $\mu$ F 50WV
C10	CE04W1E100	Electrolytic 10 $\mu$ F 25WV
C11	CE04W1E4R7	Electrolytic 4.7 $\mu$ F 25WV
C12	CE04W1E3R3	Electrolytic 3.3 $\mu$ F 25WV
C13, 14	CK45F1E102Z	Ceramic 0.001 $\mu$ F +80% -20%
C15	CC94SL1H220K	Ceramic 22pF $\pm$ 10%
C16	CK45F1E103Z	Ceramic 0.01 $\mu$ F +80% -20%
C17	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C18	CK45F1E103Z	Ceramic 0.01 $\mu$ F +80% -20%

Circuit No.	Parts No.	Description
C19	CC94SL1H220K	Ceramic 22pF $\pm$ 10%
C20	CE04W1C470(RL)	Electrolytic 47 $\mu$ F 16WV
C21	CC94SL1H101K	Ceramic 100pF $\pm$ 10%
C22	CE04W1E3R3	Electrolytic 3.3 $\mu$ F 25WV
C23	CK45F1E103Z	Ceramic 0.01 $\mu$ F +80% -20%
C24	CQ92M1H473K	Mylar 0.047 $\mu$ F $\pm$ 10%
C25	CK45F1E103Z	Ceramic 0.01 $\mu$ F +80% -20%
C26	CC94SL1H271K	Ceramic 270pF $\pm$ 10%
C29	CK45F1E403Z	Ceramic 0.04 $\mu$ F +80% -20%

<b>RESISTOR</b>		
R1	PD14BY2E332J	Carbon 3.3k $\Omega$ $\pm$ 5% 1/4W
R2	PD14BY2E473J	Carbon 47k $\Omega$ $\pm$ 5% 1/4W
R3	PD14BY2E101J	Carbon 100 $\Omega$ $\pm$ 5% 1/4W
R4	PD14BY2E222J	Carbon 2.2k $\Omega$ $\pm$ 5% 1/4W
R5	PD14BY2E123J	Carbon 12k $\Omega$ $\pm$ 5% 1/4W
R6	PD14BY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R7, 8	PD14BY2E223J	Carbon 22k $\Omega$ $\pm$ 5% 1/4W
R9	PD14BY2E154J	Carbon 150k $\Omega$ $\pm$ 5% 1/4W
R10	PD14BY2E221J	Carbon 220 $\Omega$ $\pm$ 5% 1/4W
R11	PD14BY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R12	PD14BY2E821J	Carbon 820 $\Omega$ $\pm$ 5% 1/4W
R13, 14	PD14BY2E221J	Carbon 220 $\Omega$ $\pm$ 5% 1/4W
R15	PD14BY2E331J	Carbon 330 $\Omega$ $\pm$ 5% 1/4W
R16	PD14BY2E474J	Carbon 470k $\Omega$ $\pm$ 5% 1/4W
R17	PD14CY2E221J	Carbon 220 $\Omega$ $\pm$ 5% 1/4W
R18	PD14CY2E681J	Carbon 680 $\Omega$ $\pm$ 5% 1/4W
R20	PD14BY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
R21	PD14BY2E183J	Carbon 18k $\Omega$ $\pm$ 5% 1/4W
R22	PD14CY2E474J	Carbon 470k $\Omega$ $\pm$ 5% 1/4W
R23	PD14CY2E152J	Carbon 1.5k $\Omega$ $\pm$ 5% 1/4W
R24	PD14CY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W

<b>SEMICONDUCTOR</b>		
D1 ~ 8		Diode 1N60
D9 ~ 11		Diode 1S1555
Q1		FET 2SK24E
Q2, 3		Transistor 2SC733Y
Q4		FET 3SK35GR

<b>COIL</b>		
L1	L33-0104-05	Ferri-inductor
L3	L33-0101-05	Ferri-inductor
T1	L30-0021-05	Balanced modulator coil (3.395 MHz)

<b>MISCELLANEOUS</b>		
RL1	S51-1002-05	Reed relay
TC1, 2	C05-0015-15	Ceramic trimmer
VR2	R12-0054-05	Trimmer potentiometer 100 $\Omega$ (B)
VR3	R12-1012-05	Trimmer potentiometer 1k $\Omega$ (B)

## ■ PARTS LISTS OF VOX UNIT (X54-0001-00)

Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
C1	CK45F1E103Z	Ceramic 0.01 $\mu$ F +80% -20%
C2	CE04W0F470	Electrolytic 47 $\mu$ F 3.15WV
C3	CK94YG1E403Z	Ceramic 0.04 $\mu$ F +80% -20%



Circuit No.	Parts No.	Description
C4	CK94YG1E203Z	Ceramic 0.02 $\mu$ F +80% -20%
C5	CE04W1H3R3	Electrolytic 3.3 $\mu$ F 50WV
C6	CE04W1H010	Electrolytic 1 $\mu$ F 50WV
C7	CK94YY1H472M	Ceramic 0.0047 $\mu$ F $\pm$ 20%
C8	CK94YG1E403Z	Ceramic 0.04 $\mu$ F +80% -20%
C9, 10	CE04W1H3R3	Electrolytic 3.3 $\mu$ F 50WV
C24	CC45SL1H331K	Ceramic 330pF $\pm$ 10%
C25	CK45F1E103Z	Ceramic 0.01 $\mu$ F +80% -20%
<b>RESISTOR</b>		
R1	PD14CY2E104J	Carbon 100k $\Omega$ $\pm$ 5% 1/4W
R2	PD14CY2E223J	Carbon 22k $\Omega$ $\pm$ 5% 1/4W
R3	PD14CY2E334J	Carbon 330k $\Omega$ $\pm$ 5% 1/4W
R4	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
R5	PD14CY2E334J	Carbon 330k $\Omega$ $\pm$ 5% 1/4W
R6	PD14CY2E563J	Carbon 56k $\Omega$ $\pm$ 5% 1/4W
R7	PD14CY2E562J	Carbon 5.6k $\Omega$ $\pm$ 5% 1/4W
R8	PD14CY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R9	PD14CY2E222J	Carbon 2.2k $\Omega$ $\pm$ 5% 1/4W
R10	PD14CY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R11	PD14CY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R12	PD14CY2E153J	Carbon 15k $\Omega$ $\pm$ 5% 1/4W
R13, 14	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
R15	PD14CY2E471J	Carbon 470 $\Omega$ $\pm$ 5% 1/4W
R16	PD14CY2E4R7J	Carbon 4.7 $\Omega$ $\pm$ 5% 1/4W
R17	PD14CY2E473J	Carbon 47k $\Omega$ $\pm$ 5% 1/4W
R18	PD14B2Y2B102J	Carbon 1k $\Omega$ $\pm$ 5% 1/8W
<b>SEMICONDUCTOR</b>		
D1 ~ 4		Diode 1N60
D5		Diode S-1.5-01
D6 ~ 8		Diode 1N60
Q1 ~ 4		Transistor 2SC373
Q5		Transistor 2SA562-Y
Q6, 7		Transistor 2SC373
Q8		Transistor 2SA562-Y
<b>MISCELLANEOUS</b>		
T1	L13-0001-05	Input transformer

#### ■ PARTS LISTS OF NB UNIT (X54-1080-10)

Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
C1, 2	CC45SL1H020D	Ceramic 2pF $\pm$ 0.5pF
C3	CK45F1H203Z	Ceramic 0.02 $\mu$ F +80% -20%
C4	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C5, 6	CC45SL1H010J	Ceramic 100pF $\pm$ 5%
C7	CE04W1E100(RL)	Electrolytic 10 $\mu$ F 25WV
C8, 9	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C10, 11	CK45F1H203Z	Ceramic 0.02 $\mu$ F +80% -20%
C12	CK45D1H102M	Ceramic 0.001 $\mu$ F $\pm$ 20%
C13, 14	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C15	CE04W1H010(RL)	Electrolytic 1 $\mu$ F 50WV
C16	CK45F1H203Z	Ceramic 0.02 $\mu$ F +80% -20%
C17	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C18	CK45D1H102M	Ceramic 0.001 $\mu$ F $\pm$ 20%
C19	CC45SL1H331J	Ceramic 330pF $\pm$ 5%
C20	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
C21	CK45F1E403Z	Ceramic 0.04 $\mu$ F +80% -20%
C22	CK45F1H203Z	Ceramic 0.02 $\mu$ F +80% -20%
C23, 24	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%

Circuit No.	Parts No.	Description
<b>RESISTOR</b>		
R1	PD14CY2E151J	Carbon 150 $\Omega$ $\pm$ 5% 1/4W
R2	PD14CY2E221J	Carbon 220 $\Omega$ $\pm$ 5% 1/4W
R3	PD14CY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R4	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
R5	PD14CY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R6	PD14CY2E472J	Carbon 4.7k $\Omega$ $\pm$ 5% 1/4W
R7	PD14CY2E682J	Carbon 6.8k $\Omega$ $\pm$ 5% 1/4W
R8	PD14CY2E221J	Carbon 220 $\Omega$ $\pm$ 5% 1/4W
R9	PD14CY2E223J	Carbon 22k $\Omega$ $\pm$ 5% 1/4W
R10	PD14CY2E333J	Carbon 33k $\Omega$ $\pm$ 5% 1/4W
R11	PD14CY2E683J	Carbon 68k $\Omega$ $\pm$ 5% 1/4W
R12	PD14CY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R13	PD14CY2E471J	Carbon 470 $\Omega$ $\pm$ 5% 1/4W
R14, 15	PD14CY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R16	PD14CY2E333J	Carbon 33k $\Omega$ $\pm$ 5% 1/4W
R17	PD14CY2E103J	Carbon 10k $\Omega$ $\pm$ 5% 1/4W
R18	PD14CY2E222J	Carbon 2.2k $\Omega$ $\pm$ 5% 1/4W
<b>SEMICONDUCTOR</b>		
Q1		FET 3SK22(GR)
Q2		FET 2SK19(GR)
Q3		IC TA7045M(R)
Q4		Transistor 2SC460B
Q5, 6		Transistor 2SC733(Y)
D1 ~ 4		Diode 1S73A
D5, 6		Diode 1N60
D7		Varistor MV-13
<b>COIL</b>		
T1 ~ 3	L30-0010-05	IFT 3395KHz
T4	L31-0286-05	NB coil (A) 3395KHz
T5	L31-0287-05	NB coil (B) 3395KHz
T6	L30-0010-05	IFT 3395KHz
T7	L30-0021-05	IFT 3395KHz
L1, 2	L33-0104-05	Ferri-inductor

#### ■ PARTS LISTS OF FAN UNIT (X54-1100-01)

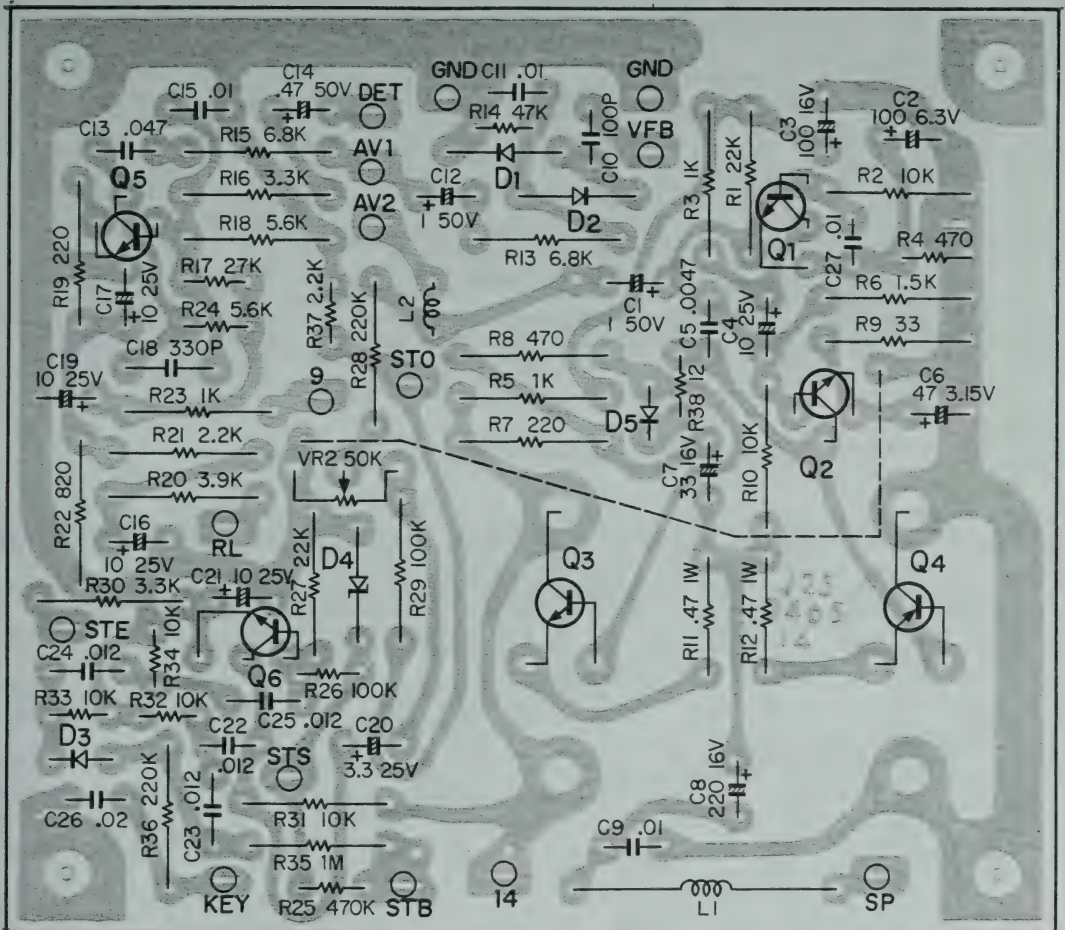
Circuit No.	Parts No.	Description
<b>MISCELLANEOUS</b>		
-	E22-0207-05	Lug board x 2
-	F07-0316-04	Fan cover
-	F09-0020-05	Fan 75 $\phi$
-	J21-1153=-4	Fan motor mounting hardware
-	J32-0117-04	Hexagon boss
-	L33-0025-05	Heater choke (1 $\mu$ H) x 2
-	T40-0012-05	Motor 100V

■ PARTS LISTS OF INDICATOR UNIT  
(X54-1120-00)

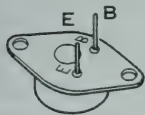
Circuit No.	Parts No.	Description
<b>RESISTOR</b>		
R1	PD14BY2E681J	Carbon 680Ω ±5% 1/4W
R2	PD14BY2E471J	Carbon 470Ω ±5% 1/4W
R3	PD14BY2E681J	Carbon 680Ω ±5% 1/4W
<b>SEMICONDUCTOR</b>		
D1 ~ 3		LED TLR-104
<b>MISCELLANEOUS</b>		
—	A30-0079-14	Dial back board
—	E23-0046-04	Terminal
—	J21-1150-14	Indicator mounting hardware
—	J32-0074-04	Hexagon boss x 2



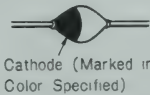
# PC BOARD



Q1,6:2SC733(Y) Q2:2SC734(Y) Q3:2SD90(O) Q4:2SB473(C.D.N) Q5:2SC1000(GR)  
D1,2:1N60 D3:1S1555 D4:WZ-130 D5:V06B



2SD90  
2SB473



Cathode (Marked in  
Color Specified)

V06B: Yellow

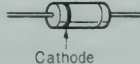


1S1555

Cathode



2SC1000  
2SC733  
2SC734



Cathode

WZ-130



Cathode

1N60

Figure 21. AF Board (X49-0008-01) Diagram

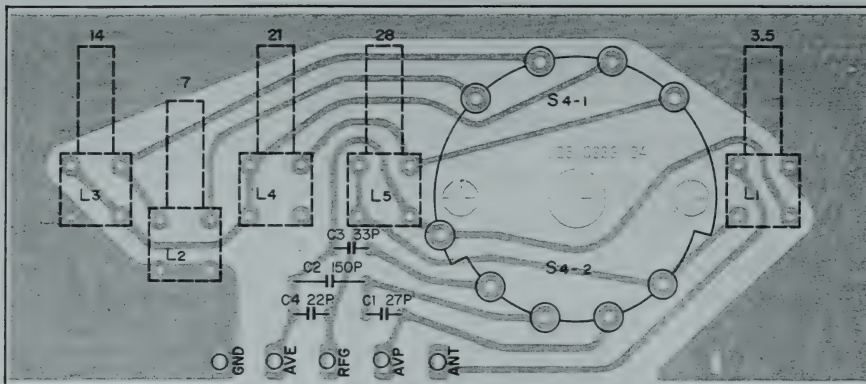
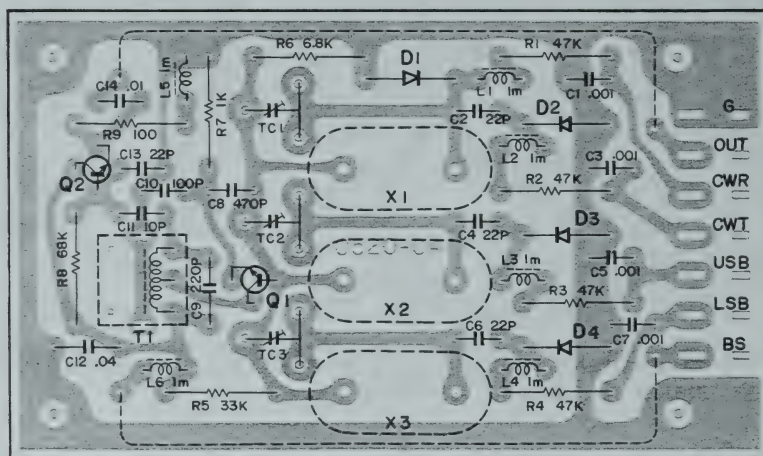


Figure 22. ANTENNA COIL Board (X44-1090-00) Diagram



Q1,2 : 2SC460(B), D1~4 : IS1555

2SC460

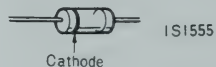
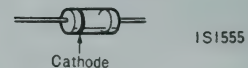
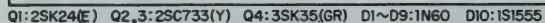


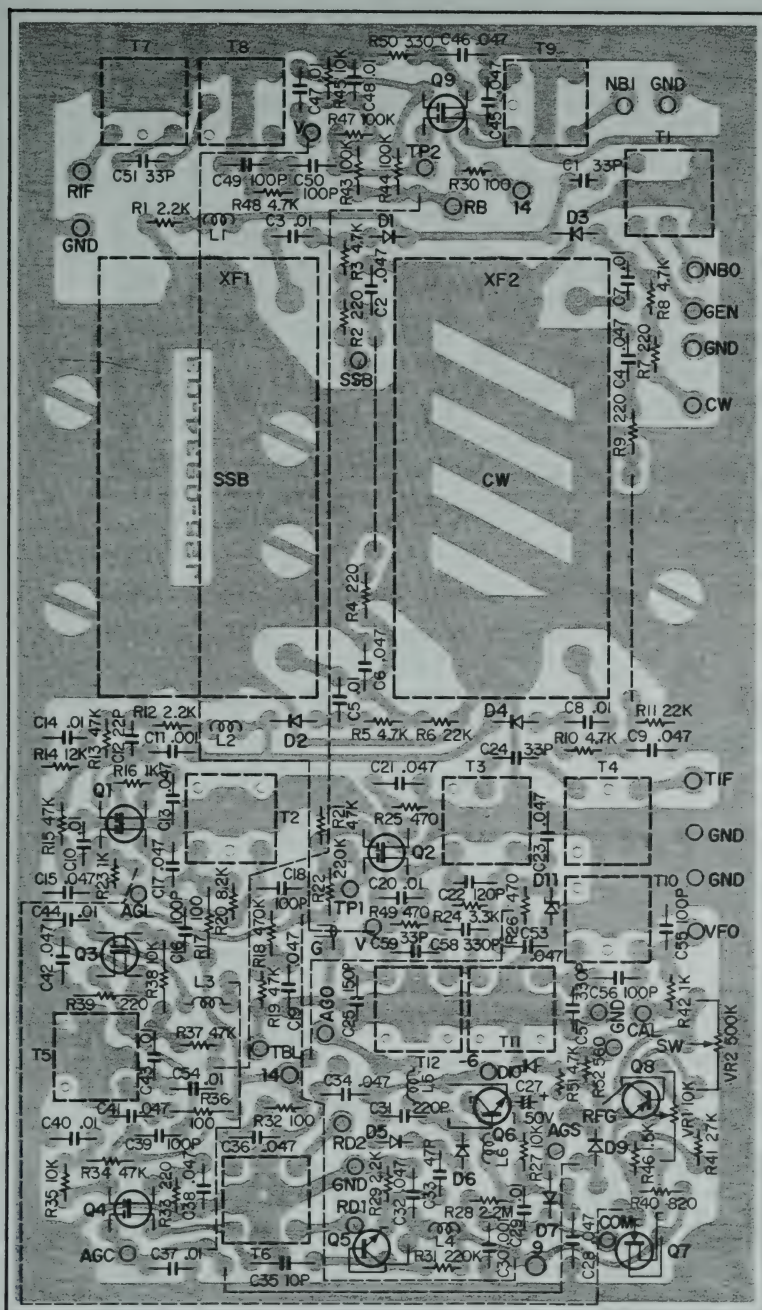
Figure 23. CARRIER Board (X50-0009-01) Diagram











Q1,3,4,9:3SK35(GR) Q2:3SK41(L) Q5,6:2SC733(Y) Q7:2SK19(GR) Q8:2SA495(Y)  
 D1~4:1S73A D5,6:1N60 D7,9,10:1S1555 D11:WZ-090

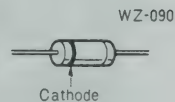
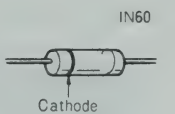
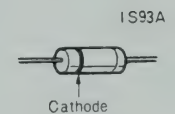
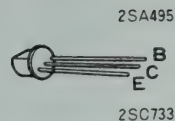
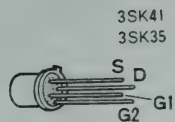
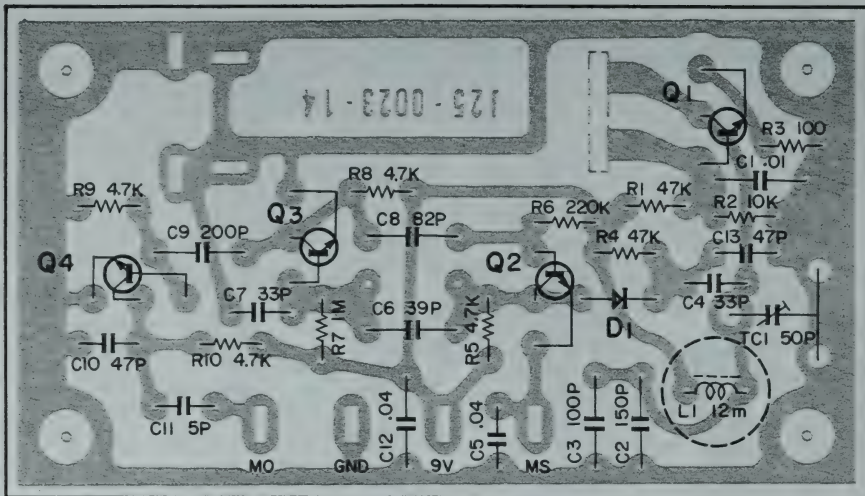


Figure 28. IF Board (X48-1060-00) Diagram



Q1,4:2SC373 or 2SC458(B), Q2,3:2SC373, D1:1N60



2SC373



Cathode

1N60

Figure 29. MARKER Board (X52-0005-01) Diagram

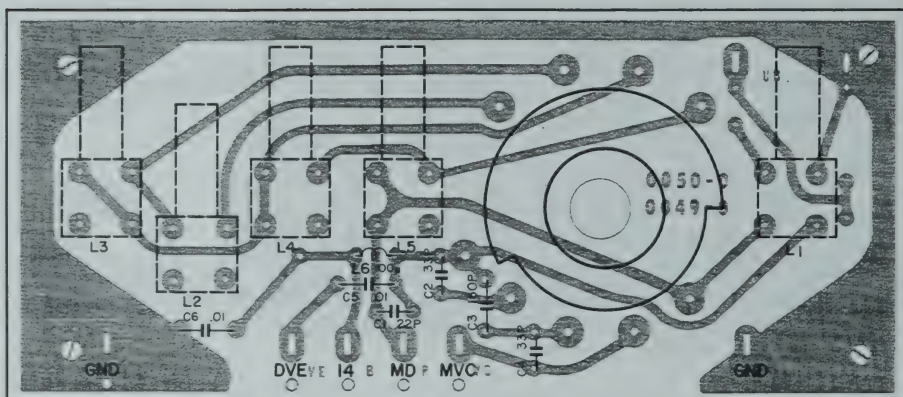
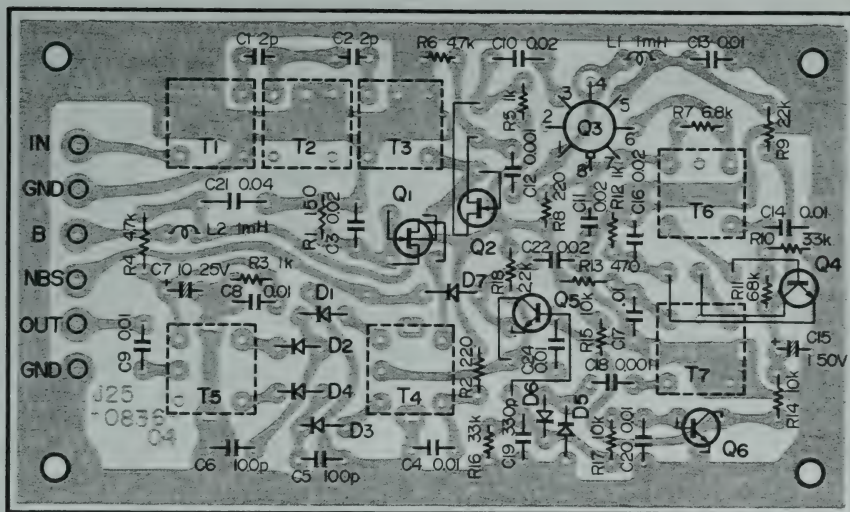


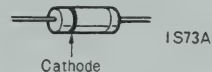
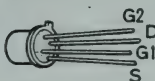
Figure 30. MIXER COIL Board (X40-0018-01) Diagram





DI~4 : 1S73A      D5,6 : 1N60      D7 : MV-13      Q1 : 3SK22(GR)  
 Q2 : 2SK19 (GR)      Q3 : TA7045M (R)      Q4 : 2SC460 B      Q5,6 : 2SC733 (Y)

3SK22



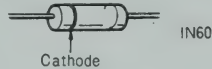
2SK19



TA-7045



2SC460



2SC733

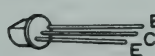


Figure 31. NB BOARD (X54-1080-10) Board

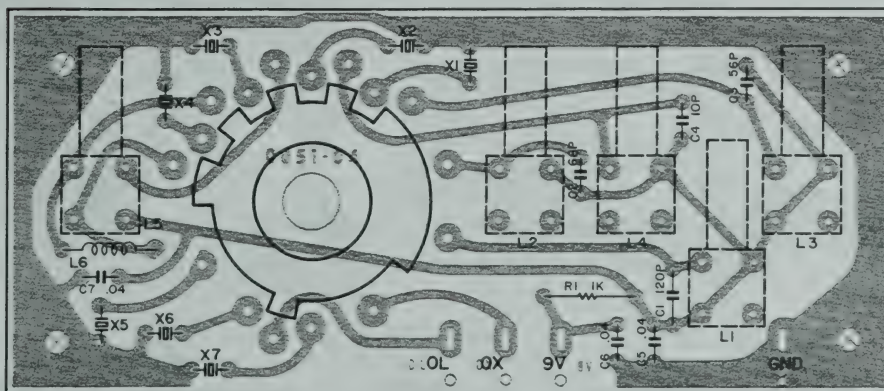
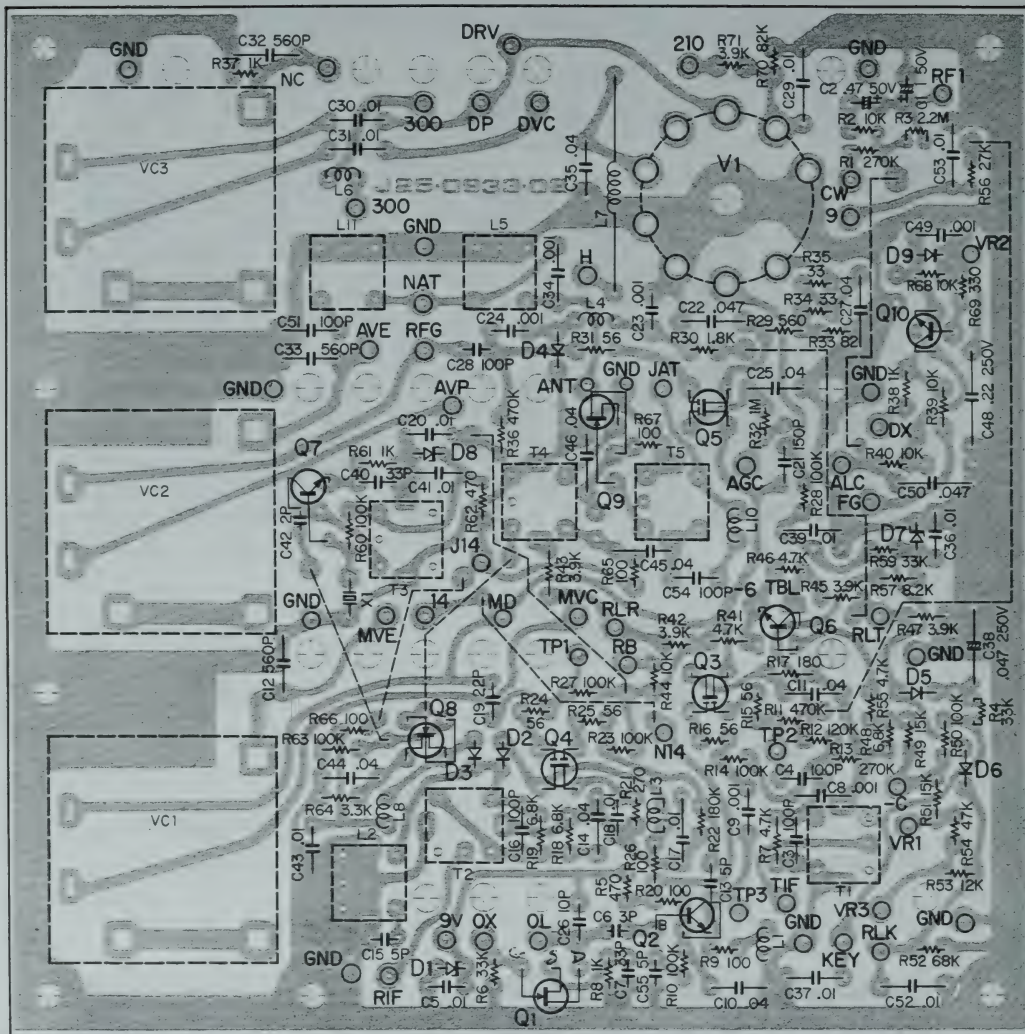


Figure 32. OSCILLATOR COIL Board (X40-0019-01) Diagram

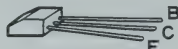


Q1,9:2SK19(GR) Q2:2SC460(B) Q3:3SK41(L) Q4:3SK35(GR) Q5:3SK35(Y) Q6:2SC733(Y) Q7:2SC535(A)  
 Q8:3SK22(GR) Q10:2SC856 V1:12BY7A D1,7,8:WZ-090 D2~4:1S73A D5,6:V06B D9:1S1555

2SK19



3SK41  
3SK35



3SK22



2SC856

2SC733



WZ-090



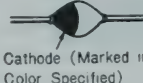
Cathode

1S73A



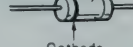
Cathode

V06B: Yellow



Cathode (Marked in  
Color Specified)

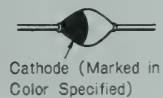
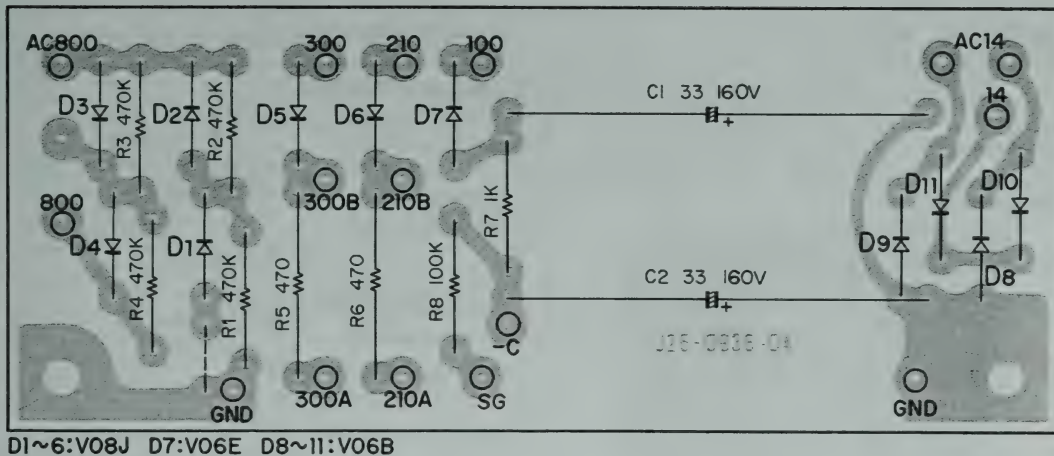
1S1555



Cathode

Figure 33. RF Board (X44-1080-00) Diagram





V06B: Yellow  
V08J: Green  
V06E: Red

Figure 34. RECTIFIER Board (X43-1090-00) Diagram

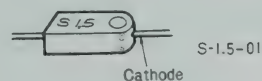
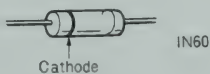
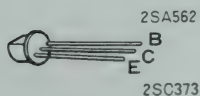
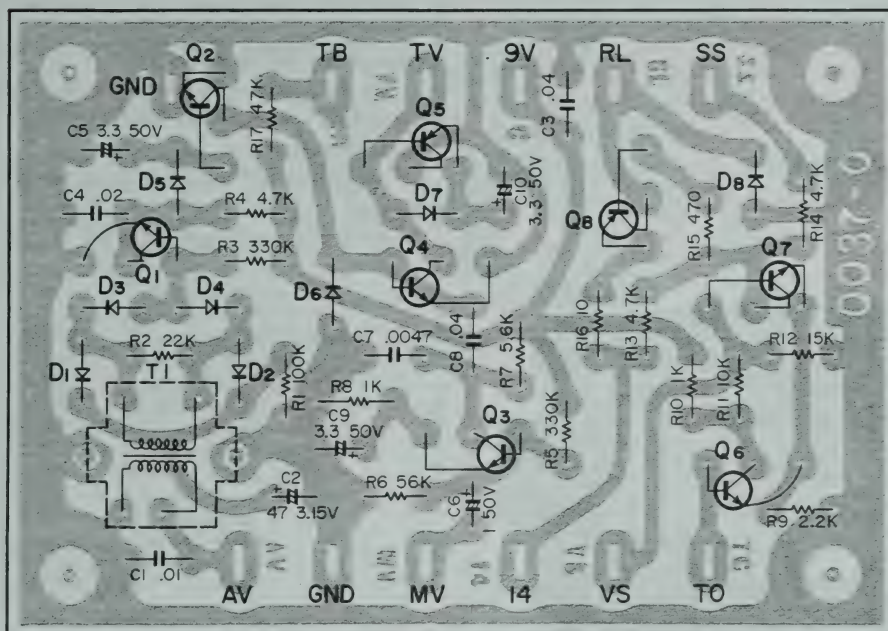
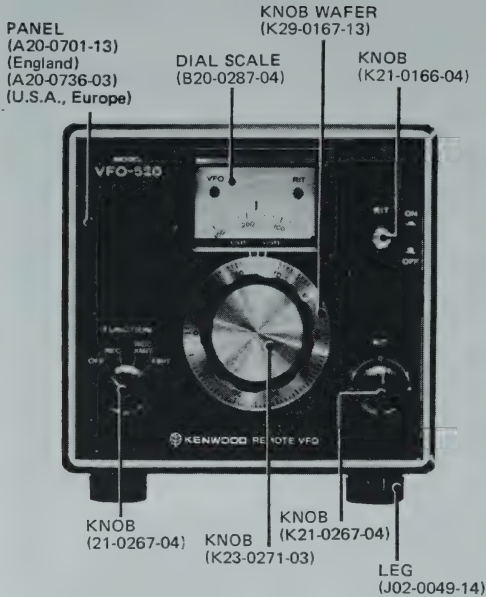


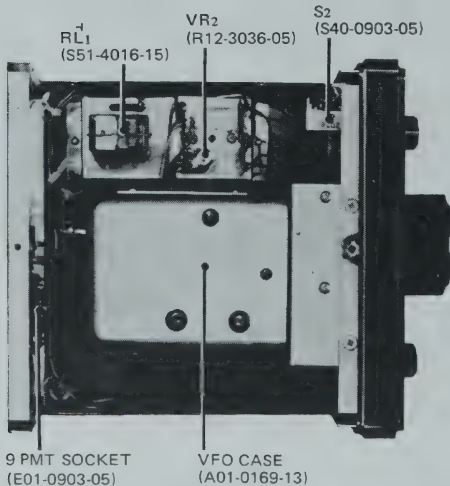
Figure 35. VOX Board (X54-0001-00) Diagram

# VFO-520

## EXTERNAL VIEW



## TOP VIEW PARTS



## SPECIFICATION

### FREQUENCY RANGE:

80 meter band	3.5 to 4.0 MHz.
40 meter band	7.0 to 7.5 MHz.
20 meter band	14.0 to 14.5 MHz.
15 meter band	21.0 to 21.5 MHz.
10 meter band	A 28.0 to 28.5 MHz.
	B 28.5 to 29.1 MHz.
	C 29.1 to 29.7 MHz.

### OSCILLATION FREQUENCY:

4.9 to 5.5 MHz.

### OSCILLATION CIRCUIT:

VFO: Clapp Oscillator.

### OUTPUT VOLTAGE:

1 volt  $\pm 3$  db (across a 470 ohm load).

### FREQUENCY STABILITY:

Within  $\pm 100$  Hz per 30 minutes after 3 minutes of warm-up

### SOLID STATE COMPLEMENT:

2 transistors.  
2 FET's  
6 diodes.

### POWER REQUIREMENTS:

The VFO-520 receives power from the TS-520.  
12.6 VAC, 80 ma. 12.6 VDC, 40 ma. 9.0 VDC, 25 ma.

### DIMENSIONS:

6.5" wide x 5.9" high x 7.5" (excluding feet).

### WEIGHT:

6.6 lbs. (shipping weight 8.36 lbs.)



# VFO-520

## ■ PARTS LISTS OF VFO-520 (Y57-1020-00)

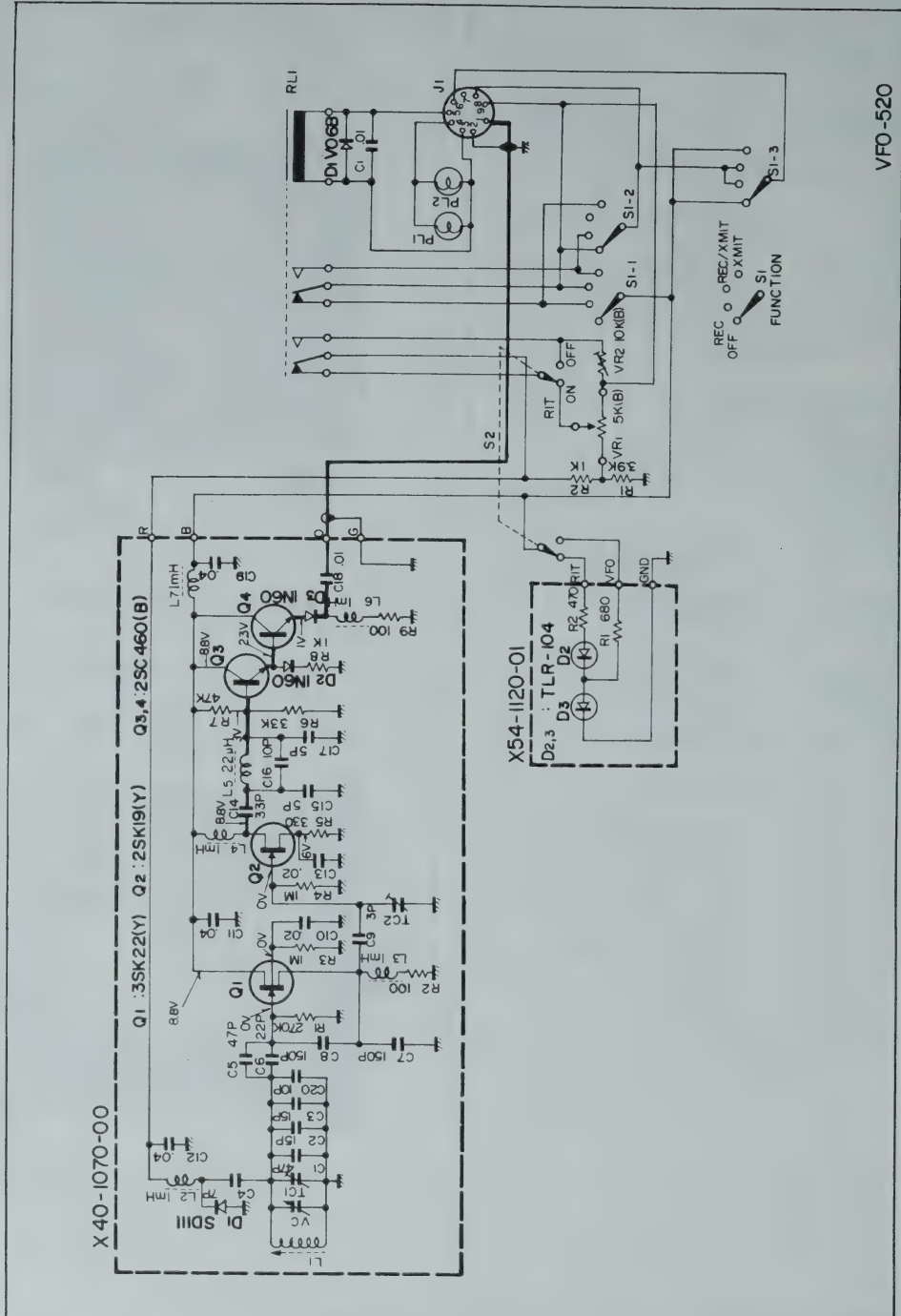
Circuit No.	Parts No.	Description
<b>CAPACITOR</b>		
C2	CK45F1H103Z	Ceramic 0.01 $\mu$ F +80% -20%
<b>RESISTOR</b>		
R1	PD14BY2E102J	Carbon 1k $\Omega$ $\pm$ 5% 1/4W
R2	PD14BY2E392J	Carbon 3.9k $\Omega$ $\pm$ 5% 1/4W
<b>SEMICONDUCTOR</b>		
D2		Diode V06B
<b>MISCELLANEOUS</b>		
—	A01-0212-13	Case (A)
—	A01-0213-03	Case (B)
—	A20-0701-13	Panel (England)
—	A20-0736-03	Panel (U.S.A., Europe)
—	A22-0136-23	Sub panel
—	A23-0430-03	Rear panel
—	B01-0078-23	Escutcheon
—	B10-0131-04	Front glass
—	B20-0287-14	Dial scale
PL1, 2	B30-0079-05	Pilot lamp (12V 40mA)
—	B40-0855-04	Name plate (serial)
—	B42-0009-04	Passed sticker (Europe, England)
—	B46-0047-00	WARRANTY card (U.S.A.)
—	B50-1108-00	Operating manual (U.S.A., Europe)
—	B50-1109-00	Operating manual (England)
—	D23-0115-05	Ball bearing
—	D23-0116-05	Ball bearing ass'y
J1	E01-0903-05	9P MT socket
—	E05-0904-05	9P MT plug
—	E09-0204-05	2P plug
—	E14-0101-05	1P plug
—	E22-0405-04	Lug board
—	F15-0161-04	Shading plate
—	H01-1015-04	Carton case (Inside) (England)
—	H01-1044-04	Carton case (Inside) (U.S.A., Europe)
—	H03-0285-04	Carton case (Outside) (U.S.A., Europe)
—	H03-0303-04	Carton case (Outside) (England)
—	H10-0933-03	Polystyrene foamed fixture
—	H10-0935-04	Protection Board
—	H10-0968-03	Polystyrene foamed fixture
—	H20-0372-04	Protection cover
—	H25-0002-04	Accessory bag
—	H25-0029-04	Accessory bag
—	H25-0078-00	Instruction bag

Circuit No.	Parts No.	Description
—	J01-0025-04	Sub let
—	J02-0049-14	Leg x 4
—	J19-0360-04	Coupling clamp
—	J21-1145-04	Pilot lamp
—	J21-1147-04	Coupling mounting hardware
—	J21-1152-04	Relay mounting hardware
—	J32-1030-14	Round boss x 2
—	J32-0185-04	Hexagonal boss x 2
—	J41-0020-04	Knob bushing
—	J61-0019-05	Cable wrapping band
—	K21-0267-04	Knob (RIT) x 2
—	K23-0271-03	Knob (MAIN)
—	K29-0166-04	Knob (Push)
—	K29-0167-23	Knob wafer
VR1	R03-2020-05	Variable resistor 5k $\Omega$ (B)
VR2	R12-3036-05	Variable resistor 10k $\Omega$ (B)
S1	S10-1102-05	Rotary switch (FUNCTION)
S2	S40-2023-05	Push switch (RIT)
RL1	S51-4016-15	Relay
—	X40-1070-00	VFO unit
—	X54-1120-01	Indicator unit

## ■ PARTS LIST OF INDICATOR UNIT (X54-1120-01)

Circuit No.	Parts No.	Description
—	E23-0046-04	Terminal
R1	PD14BY2E681J	Carbon 680 $\Omega$ $\pm$ 5% 1/4W
R2	PD14BY2E471J	Carbon 470 $\Omega$ $\pm$ 5% 1/4W
D2, 3		LED (TLR-104)

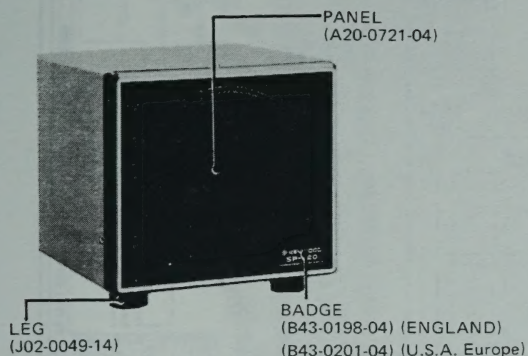
### ■ SCHEMATIC DIAGRAM





# SP-520

## EXTERNAL VIEW



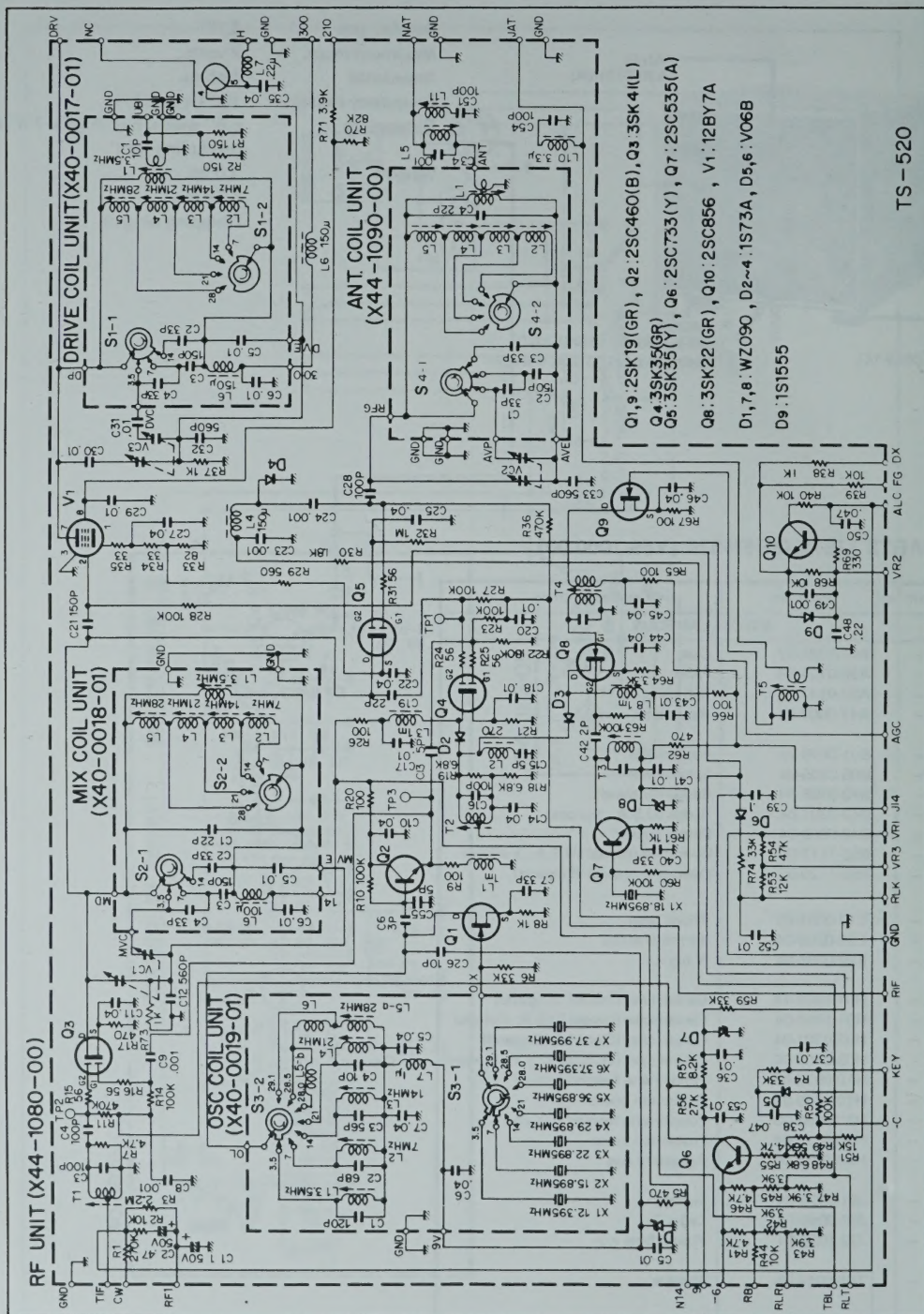
## SPECIFICATION

Speaker size	4.75"
Maximum input	2 watts
Impedance	8 ohms
Frequency response	100 Hz to 5 kHz
Dimensions	6.5" wide x 6.0" high x 7.5" deep (excluding feet)
Weight	3.0 lbs. 5.28 lbs. (shipping weight)

## PARTS LISTS OF SP-520 (Y59-1000-00)

Circuit No.	Parts No.	Description
<b>MISCELLANEOUS</b>		
—	A01-0221-12	Case
—	A20-0721-04	Panel
—	A22-0142-13	Sub panel
—	A47-0007-04	Rear plate
—	B01-0078-23	Escutcheon
—	B05-0205-04	Speaker net
—	B43-0198-04	Badge (England)
—	B43-0201-04	Badge (U.S.A., Europe)
—	B42-0009-04	Passed sticker
—	B50-1111-00	Operating manual (U.S.A., Europe)
—	B50-1120-00	Operating manual (England)
—	E12-0001-05	Phone plug
—	E20-0208-04	Terminal strips
—	E29-0005-04	Y lug x 2
—	H01-1032-14	Carton case (Inside) (England)
—	H01-1068-04	Carton case (Inside) (U.S.A., Europe)
—	H03-0301-04	Carton case (Outside) (England)
—	H03-0302-04	Carton case (Outside) (U.S.A., Europe)
—	H10-0933-03	Polystyrene foamed fixture
—	H10-0935-04	Protection board
—	H10-0968-03	Polystyrene foamed fixture
—	H20-0372-04	Protection cover
—	H25-0016-00	Accessory bag
—	J01-0025-04	Sub leg
—	J02-0049-14	Leg x 2
—	J32-1030-14	Round boss x 2
—	T06-0011-05	Speaker

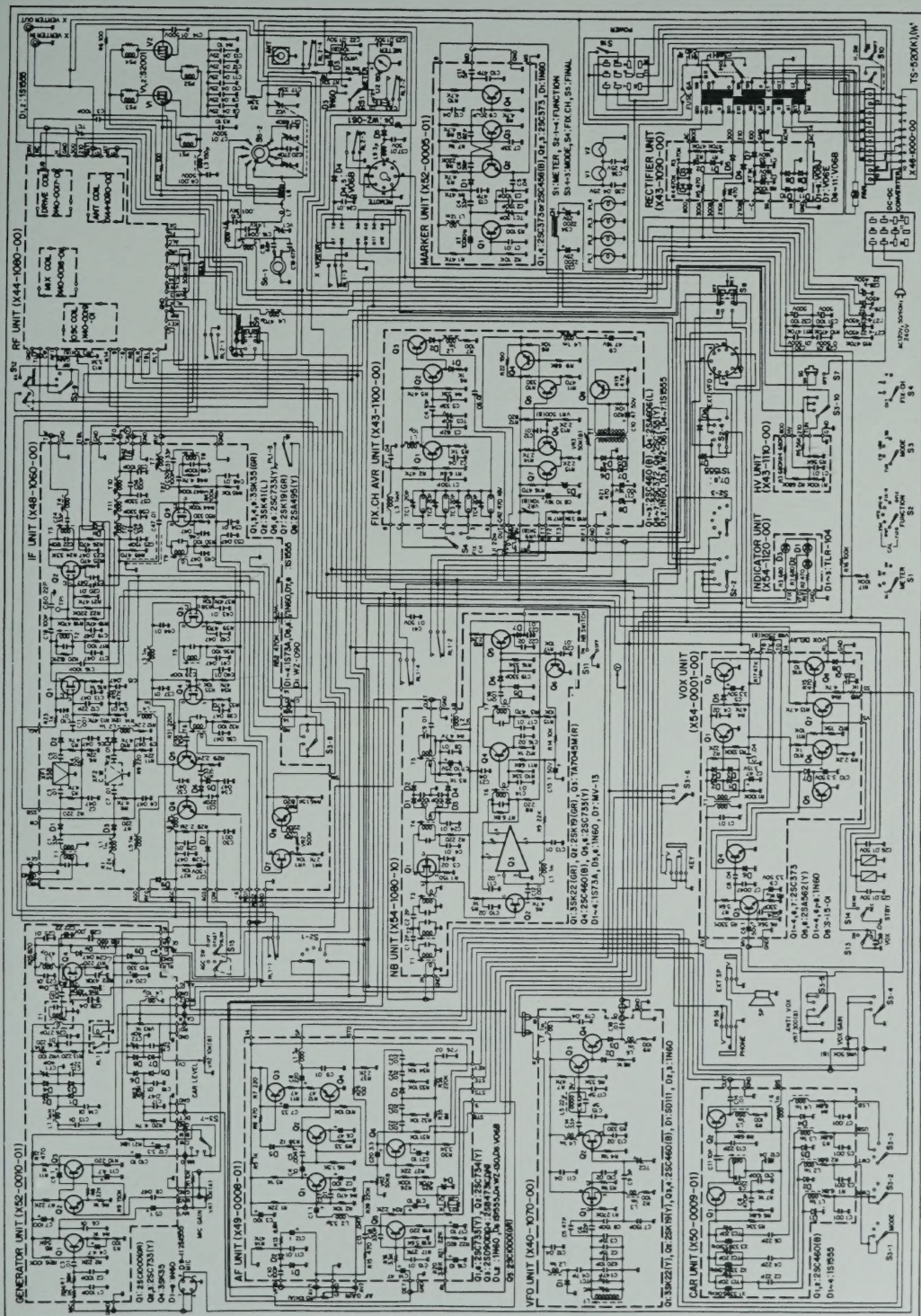
# SCHEMATIC DIAGRAM(RF UNIT)

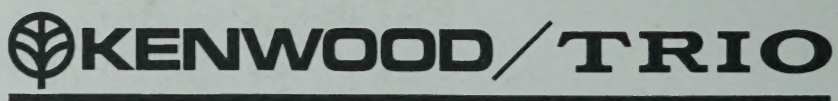


TS-520



# SCHEMATIC DIAGRAM (TS-520)





Manufactured by TRIO ELECTRONICS, INC., Tokyo, Japan